THE MARINE REVIEW

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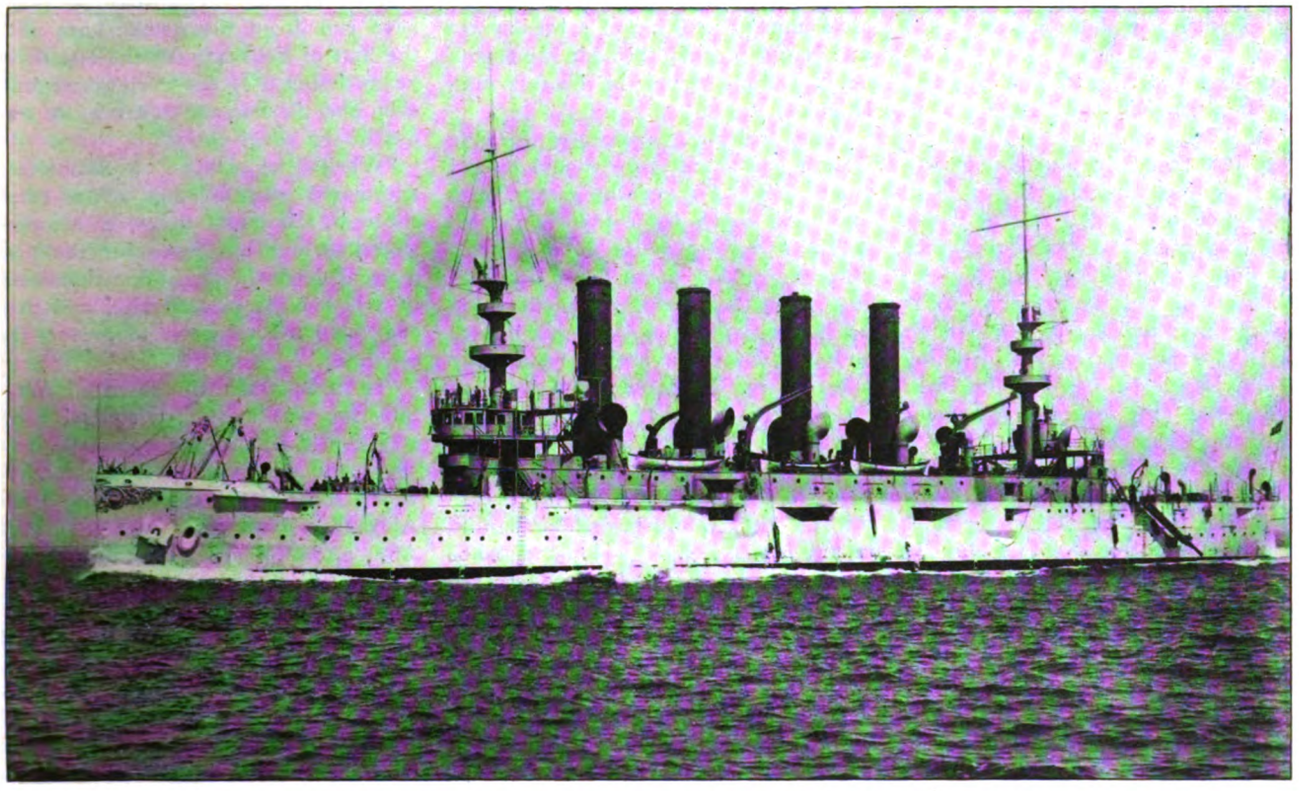
ACCOMMODATING 600,000,000 TONS.

Mr. Wm. Livingstone, president of the Lake Carriers' Association, recently gave a dinner at the Country Club, Detroit, in honor of Mr. Joseph Ripley, who has just resigned the superintendency of the Sault Ste. Marie canals to direct the construction of the locks of the Panama canal. At the dinner Supt. Ripley stated that three canals with two locks would provide facilities for the passage of 600,000,000 tons of freight. Upon being asked later for data to substantiate this statement, he has submitted the following.

"My statement at the dinner that three canals with two locks each would provide ample channelways and lockage facilities for a possible future commerce of 600,000,000 tons annually passing the rapids was based on the following data: With an available draught of 18 to 20 ft. during the season of 1905 there were 36,543,484 tons of freight passed through the Poe lock in 5,288 lockages. There were vessels in the lock 3,086 hours of the total number of 5,904 hours, or 52 per cent of the time the lock was in commission. Addition 9 minutes (double the observed time) to each lockage for time of traversing 400 ft. of approaches to lock by last outgoing and first incoming ship would reduce the idle time to 2,025 hours, or 34 per cent of the total. If the lock had been continuously employed, and average rate maintained, the traffic would have amounted to 48,968,268 tons. The Poe lock, however, passed only 2,399 vessels without cargo, while its proportion should have been 3,153 such vessels. Taking average number of vessels per lockage, viz., 1.8, and average time of lockage at 35 minutes, the idle time will be reduced to 1,781 hours, or 30 per cent of the total, and the amount of freight would be 47,406,529 tons. If similarly computed on traffic of month of June, 1906, of 5,861,127 tons in 745 lockages, and 444 hours of operation, the amount would be 62,232,064 tons; and similarly based on traffic of June 25, 1906, of 284,293 tons in 28 lockages, and time of 18 hours 7



THE ARMORED CRUISER MILWAUKEE, WHICH RECENTLY UNDERWENT HER TRIAL TRIP.

Built by the Union Iron Works, San Francisco.

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minutes, the amount would be 75,268,096 tons.

"The proposed new lock, 1,350 ft. long and 80 ft. wide, will have at least one-third greater capacity than the Poe lock under conditions of present draught and size of ships, and taking the annual capacity of the Poe lock at 50,000,000 tons, gives a total for the two locks of over 116,000,000 tons.

"On completion of the new lock the navigable draught through St. Mary's river will be 21 ft. at lowest stage of water, or 24½ ft. at present stage; an increase of 5 ft. over present draught of 19½ ft. This means that the average ship of today could carry over one-third more cargo, which, added to the 116,000,000 tons, makes the total for two locks 155,000,000 tons, when the water surface is about 1 ft. below the normal stage of the past 35 years.

"For safe and efficient operation not more than two locks should connect with one canal prism 200 to 300 ft. in width, as fluctuations of the water surface, caused by filling or emptying the locks, interfere with operating the gates.

"Unquestionably, a second lock will be built in connection with the Canadian canal whenever the construction thereof is warranted by needs of commerce. A third canal with two locks can be built near center line at rapids at less cost and with better approaches than along south shore adjacent to present canal, and its location so far from the present canals would minimize the fluctuations caused by filling or emptying locks. As both locks would be of the largest dimensions named, its capacity would be greater than either of the shore canals. Based on 155,000,000 tons for one canal, the three canals could annually pass more than 465,000,000 tons of freight in ships of present average size, and to that amount can safely be added 25 per cent for the larger class of ships which will be in use when there is a freight movement of such gigantic proportions.

"The original canal lands, together with those recently acquired, including the tract below the locks, and that parcel of 8¾ acres located north of the canal and deeded by the Chandler & Dunbar Co., and Island No. 5, to be purchased, will provide ample space for the new lock either north or south of the Poe lock.

"The other principal factor to be considered is the quantity of water required for ship canal purposes.

"The American and Canadian ship canals are now using about 600 cu. ft. per second, which includes lockage, leakage and power development for operating lock machinery. The similar amount required for continuous operation of six locks of the stated dimensions would be less than 3,000 cu. ft. per second. The International Waterways Commission has stated that 61,000 second feet may be taken as the ordinary low water discharge of St. Mary's river at the rapids, and that of this amount not less than 4,000 second feet should be reserved for use of locks and the passage of logs. With the above provisions as to water supply, land areas, canals and locks ample for yearly passage of 600,000,000 tons of freight, it would seem that the interests of navigation were well conserved.

"I favor building the canal in the rapids first, then when the traffic warrants, to build a new lock for the present canal south of the Poe lock."

CAPT. McDOUGALL'S ARGUMENT.

Capt. Alexander McDougall presents his argument in favor of a breakwater as against a canal through Minnesota point, Duluth harbor, in the following language:

"The proposed breakwater for the Duluth harbor entrance should extend from about Fourteenth avenue east one mile south by southeast, which would terminate it in about 65 ft. of water, with a mean depth of about 40 ft. Such a breakwater would overlap the ends of the present canal entry and would form a harbor nearly one mile square. By looking at a map of the western end of Lake Superior, you will observe that the waves that come from south of east are the only ones that would roll inside of this breakwater. They would have less than 20 miles sweep. Such a long distance from the end of the harbor entrance would give ample room for the largest ships that may ever be built for the lake trade in which to maneuver, and those that so desired in a storm could come under the breakwater for shelter without coming inside. This advantage would be very great in the future, when it may happen many times that 100 ships or more may come on before a northeast storm and find shelter here, or inside, as they may choose.

AS TO CENTRAL CANAL.

"The action of the northeast storm through the present entrance of the canal has been fully discussed, and it is well known the commotion which is created at all docks near the present canal entrance. If a new central canal were cut, as suggested by the representatives of the Pittsburg Steamship Co., the same disturbance, or a greater one, would occur in that portion of the harbor near the gate, or in the vicinity of Connor's and Rice's point, and greatly interfere with traffic through the two bridges directly opposite. If such an entry were made, doubtless it would be necessary to protect it with a breakwater also, which would be a greater problem than the proposed breakwater from the north shore. The question of dealing with an entry through Minnesota point is well illustrated at the Superior canal, when each storm destroys the work of the previous year. Serious trouble might occur by attempting to cut through the middle of this frail piece of land. I consider it hazardous to cut this third entry, particularly so in the face of the splendid work at the present Duluth canal.

"The closing of either of the entrances—Superior or Duluth—would close navigation at each side of the harbor, particularly at Duluth, two months earlier. The coasting boats have run down the north shore until the first of February for the last three years, because of the deep water outside, and the current that runs in and out of the canal entry.

"When the state of Minnesota authorized the opening of a canal through Minnesota point, a commission that was appointed for the purpose of determining the location wisely selected the present site, and then suggested a breakwater to protect the entrance.

"In 1880, when the town of West Superior was started, a central canal was considered, and a commission of engineers appointed to investigate, of which the present chief of engineers, Alexander McKenzie, was chairman. After an investigation they decided the entry was in the proper place.

"In 1890 Major Quinn was authorized to make a report on the Duluth entry, when accepting the land for the United States government whereon the canal was located, and after a full investigation of results of previous storms and disasters, he recommended that the canal remain where it is, and that a breakwater to cost about $1,800,000, to protect the harbor from the northeast sea, at a distance of about 4,000 feet out from the piers, be placed there.

At a later date, when Major Sears was in charge of the district, and the plan of putting in the present canal piers was considered, he made diligent inquiry among the people of Duluth and Superior and the vesselmen,

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in a general way, as to where the canal should be placed. Then, he decided, by the approval of the department, that those magnificent piers should be where they are at the present time. The question that bore most upon the subject was this: About two-thirds of the ships coming to the western end of the lake come without cargo, and the prevailing wind in the fall is northwest; when approaching the western end of Lake Superior many of them seek shelter under the north shore and when a northwester is blowing hard this is of much help to them in making a lee.

"Our severe northeast storms come sometimes after a northwester, and bring thick weather, snow, or sleet. Having the piers along the north shore it is much easier to find the entry moderately close to the mainland than if it was located three or four miles away from it. A harbor of refuge is the most essential of all to be considered, and in this case it could be found either under the breakwater, or through a canal entrance protected by a breakwater.

"The influence of the Pittsburg Steamship Co. and its officers is enormous, as indicated at the meeting in Duluth. I fear that in trying to serve the interests of the steel company we may be greatly delayed in getting what rightfully belong to this joint port of Superior and Duluth, the proposed breakwater.

SUPERIOR OPPOSED TO IT.

"In the first place, the people of Superior are nearly all opposed to the central canal, and most of the people in Duluth are in favor of a breakwater. A great majority of the people of both cities are in favor of the breakwater plan to such an extent that it would be impossible to get the joint influence of the representative men of both cities for an appropriation for a central canal.

"It is also proposed to put a lighthouse and fog signal at a point about half way between Two Harbors and Duluth and another northeast of Two Harbors as further guides to the present entry, and to enlarge the anchorage basin in the Duluth harbor."

DECK WIND SHELTER.

The North German Lloyd has just adopted for their express steamers an ingenious invention, by means of which any number of substantial wind shelters can be provided on deck at a few minutes' notice, an addition to passengers' comfort which is certain to be appreciated. One of the first things a traveler gives his attention to on arriving on board is to see to the position of his chair on deck. The configuration of deckhouses is generally modified with a view to providing one or two cosy recesses. These favored positions, however, are necessarily few; and the majority of the passengers have to incur the full blast of the wind, which, with steamers going a speed of over twenty knots, necessitates a good deal of wrapping up. By means of this invention the number of cosy corners is practically unlimited, and this immense increase in comfort is provided without in any way permanently encumbering the deck, for when not in use the shelter is stowed away with the greatest facility, while remaining ready for use at a moment's notice. The arrangement chiefly consists in providing removable transverse walls which may be conveniently placed between one deck—say the promenade deck—and the transverse girders or beams of the deck above it. The walls can be made of wood or similar material or canvas mounted upon a suitable framework. In such cases the lower edges of the walls are provided with pins which engage corresponding recesses in the deck, and their upper edges are detachably secured to the girders of the deck above by means of bolts and thumb nuts or in some other suitable manner. If desired the protective walls may be in the form of canvas sheets, in which case they are stretched by means of ropes between suitable eyes, cleats, or the like secured to the deck girders and to the deck.

NOVEL DIVING SUIT.

The obstacle to salvage at great depths is the pressure. Little is attempted beyond a depth of 50 ft. by reason of it. With this new diving suit, M. de Pluvy, the French hydraulic engineer, has, however, made considerably more than 100 descents, reaching depths of 150 to 300 ft.—much below the limits of ordinary diving. No air is received from the outside. The dress consists of an armor of sheet metal from one-fifth to one-third of an inch thick, with joints and coupling points of pressed leather and rubber, and a helmet with two cylindrical regenerating chambers attached. The air circulating through the helmet, has its oxygen continually renewed by chemicals in these chambers, regulating valves keeping the pressure in the helmet constant at all depths. Mounting and descending are effected by a cable carried on a drum driven by an electric motor, and this cable also carries the current needed for the respiratory apparatus. The diver communicates with the surface by telephone, while wires run from the armor to electric lights that show the working of the different parts of this complicated "dress."

DAMMING THE MISSISSIPPI RIVER.

Damming the Mississippi river at the Des Moines rapids, just above Keokuk, Ia., is now being seriously considered again after having been abandoned several years ago as impracticable by the last company which investigated the feasibility of the project. A Canadian syndicate, with Mr. C. P. Cooper as chief engineer, has for nearly a year been making detailed investigations to determine the most suitable site for a dam compiling statistics concerning the flow of the river and considering in detail other features governing the location and construction of such a dam. Although none of these investigations have been made public, it is generally understood that a suitable site for a dam has been located and that the project is considered feasible. Several field parties have recently started complete surveys on both sides of the river above the rapids to determine just how much land would be submerged by the proposed dam, and while it is said that much larger areas will be flooded than was anticipated, there is little probability that the value of the submerged lands will alone be great enough to render the project impracticable. The greatest difficulty to be overcome in the construction will undoubtedly be the control of the tremendous flow of the river during high water. If it is considered that the building of a dam across the river at the site chosen is possible at a reasonable cost, there is apparently no reason why it will interfere with navigation sufficiently to warrant any serious objection to it being built. The canal and locks on the Iowa side of the river at the Des Moines rapids which were built many years ago by the government, are already used by practically all of the boats plying up and down the stream, as the current over the rapids is so swift as to render navigation through the latter difficult and hazardous, except during high water. As far as a profitable disposition of the power that could be developed by a dam at these rapids is concerned, there seems to be little doubt, since a number of cities of considerable size could be reached by electrical transmission lines of reasonable length and, furthermore, the country in the immediate vicinity is fully developed.

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LIQUID FUEL FOR STEAM RAISING.

The use of liquid fuel in place of coal for raising steam in both land and marine boilers appears, says *Engineering*, to possess a great attraction for some people. If we are to judge by the number of patents that have been taken out of late years for different forms of burners, whereby petroleum and similar oils may be atomized and burned, there must be a very sanguine prospect in many minds as to the future of these fuels. At first sight the advantages of petroleum as a fuel are apt to stand out with undue prominence, and in certain cases appear so great that it is at once assumed that such fuels are on the high road towards supplanting coal entirely for most, if not all, industrial purposes. There are, however, certain important facts which are lost sight of by those who take this view. Admirable as liquid fuel is in certain situations, due to the cleanliness arising from its use, as well as to the ease with which it may be stored and transported, and its combustion regulated, it is never likely to influence to any great extent the use of coal, at any rate not until some vast new sources of supply are discovered. If we compare the world's annual output of coal with the annual supply of petroleum, we see, adds our contemporary, how enormous the difference is, and how unlikely it is that oil will ever prove anything but a very insignificant rival to the older fuel. According to a table prepared by the United States Geological Survey, the annual output of coal for the whole world is now about 840,011,900 tons, while the world's total annual production of petroleum is somewhere in the region of 200,000,000 barrels, or about 6,660,000,000 imperial gallons. If we take 3¼ barrels of petroleum as approximately equivalent for heating purposes to one ton of coal, we find that the world's total annual production of oil is equal to about 61,846,184 tons, or 7.36 per cent of the coal output. In the face of the fact, however, that probably about half of this quantity is absorbed by reason of the demand for oil for illuminating and lubricating purposes, it is clear that oil fuel can, for some time at any rate, be employed only for special purposes in particular localities. That there are special conditions under which oil fuel may be used with advantage there is, however, little doubt, one of these being in the furnaces of marine boilers, and particularly the boilers of war vessels.

ALL WANT GIANT BATTLESHIPS.

That no nation can safely formulate and follow a policy of naval construction without taking into consideration the policies of other powers, was never more forcibly illustrated than in the case of the British battleship Dreadnaught. Almost simultaneously with the launching of that vessel the United States resolved to build a ship of still greater proportions, and now France has decided that the first of the six battleships provided for in her naval budget of 1905 shall be of the Dreadnaught class. Unofficial reports state that this vessel, named the Danton, will be built at Brest, and will be the first European answer to the adoption of the Dreadnaught type of England. The reports say that the Danton is to have a displacement of 18,000 tons, will develop 22,000 H. P. and is to have a speed of 19 knots. Her armament is to consist of four 12-in. and twelve 9.5-in. guns in barbettes, besides sixteen light guns of two different calibers. Two torpedo turrets are also to be added to the vessel. It will be seen that the Danton will be a totally different type of vessel to the Dreadnaught so far as gun power is concerned. The latest idea among naval authorities is that for a first-class battleship guns of one caliber only are advisable for the main armament, but the Danton carries two types. The French naval authorities have, therefore, been either too prudent or else too timid to introduce all those innovations which the designers of the Dreadnaught have included.

SUBMARINE SIGNALS.

The Submarine Signal Co., 88 Broad street, Boston, has received the following letter from Capt. O. Cuppers of the Kaiser Wilhelm der Grosse:

"In answer of your letter of June 15, regarding our experiences with the submarine signal bells during the previous fifteen days, I beg to inform you that on passing the Nantucket, Fire island, and Sandy Hook light vessels on June 5, 6 and 12 we always heard the signals distinctly at a distance of about four miles, while the ship was going at full speed. It seems to me that the new apparatus, installed on board in Bremerhaven in May, works a good deal better than the old one did, as we generally hear the signals now one or 1½ miles farther than before.

"On this last trip we were approaching the Nantucket shoals lightship on the 3rd inst. during a dense fog, taking soundings every half hour, which corresponding with our reckoning put our position about 12 miles east of the lightship at 1:30 P. M. We then suddenly heard a steam whistle on the starboard, which caused us to stop and try our submarine signal receiver. We could then clearly make out the signals of the Nantucket lightship, while the steam whistle was not heard any more afterwards. After having gone "slow ahead" for a few minutes the sounds grew fainter and fainter, ceasing altogether at about 1:40 P. M., which together with the soundings taken at 1:30 P. M. made us sure that we had passed the lightship at that time about 5½ miles off, a suggestion that afterwards proved to be correct.

"The signals of Fire Island lightship were heard at a distance of only 1½ miles, but very distinctly from the first instant, while at Sandy Hook lightship no observations were made this time."

DIVIDENDS OF HAMBURG OWNERIES.

The following statistics have been published in Hamburg showing the rate of dividend paid by five of the largest shipping companies of that port in the past decade:

HAMBURG-AMERICAN LINE.

1896	8 per cent.
1897	6 per cent.
1898	8 per cent.
1899	8 per cent.
1900	10 per cent.
1901	6 per cent.
1902	4½ per cent.
1903	6 per cent.
1904	9 per cent.
1905	11 per cent.

"KOSMOS" COMPANY.

1896	11 per cent.
1897	7½ per cent.
1898	9 per cent.
1899	11 per cent.
1900	15 per cent.
1901	12 per cent.
1902	9 per cent.
1903	8 per cent.
1904	10 per cent.
1905	14 per cent.

HAMBURG-SOUTH AMERICAN CO.

1896	10 per cent.
1897	12 per cent.
1898	16 per cent.
1899	10 per cent.
1900	10 per cent.
1901	4 per cent.
1902	0 per cent.
1903	6 per cent.
1904	8 per cent.
1905	10 per cent.

EAST AFRICAN LINE.

1896	6 per cent.
1897	3 per cent.
1898	3 per cent.
1899	6 per cent.
1900	8 per cent.
1901	2 per cent.
1902	2½ per cent.
1903	0 per cent.
1904	0 per cent.
1905	4 per cent.

LEVANT LINE.

1896	4 per cent.
1897	6 per cent.
1898	9 per cent.
1899	7 per cent.
1900	10 per cent.
1901	6½ per cent.
1902	3 per cent.
1903	0 per cent.
1904	0 per cent.
1905	0 per cent.

The Electric Launch Co., of Bayonne, N. J., was recently awarded a contract for four 60-ft. launches to be built for the government.

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STEAMER JAMES LAUGHLIN.

Captain Geo. A. Symes, master of the big J. & L. steamer James Laughlin, has distinguished his fine ship from others on the great lakes by installing his charts and chart table in the pilot house of the boat. Most all the boats on the lakes are fitted out with the charts in the skipper's office. The new departure is an important one because the charts are accessible to the mates as well as the wheelsmen and watchmen. The Laughlin reached Ashtabula the latter part of last week with a 10,145-ton ore cargo from Allouez, coming down on a draught of 18.9 forward and 19.7 aft. She was towed through the Ashtabula draw up to the Union clams without the slightest difficulty. Her trip up the river to the Union slip was watched with interest. There are many features on the Laughlin not found on other boats. The passengers' quarters forward are complete in every way, from the luxuriously appointed observation room to the reception room and baths. The ice chest is arranged so it can be filled from the crew's quarters by means of a door opening into their hallway. A feature of the crew's quarters is a hot and cold shower bath. The captain has bath and shower.

The Laughlin has two Hyde Windlass Co. mooring engines at each end of the deck. On her pilot house she has two whistle pulls that work easier than most to be found and she has an Akers' emergency steering gear. This is a valuable acquisition because it can be brought into use in ten seconds and therefore makes a steady course certain. Her steering gear is Brown's patent telemotor, so she has no wheel chains.

WILLIAM MILLINGTON.

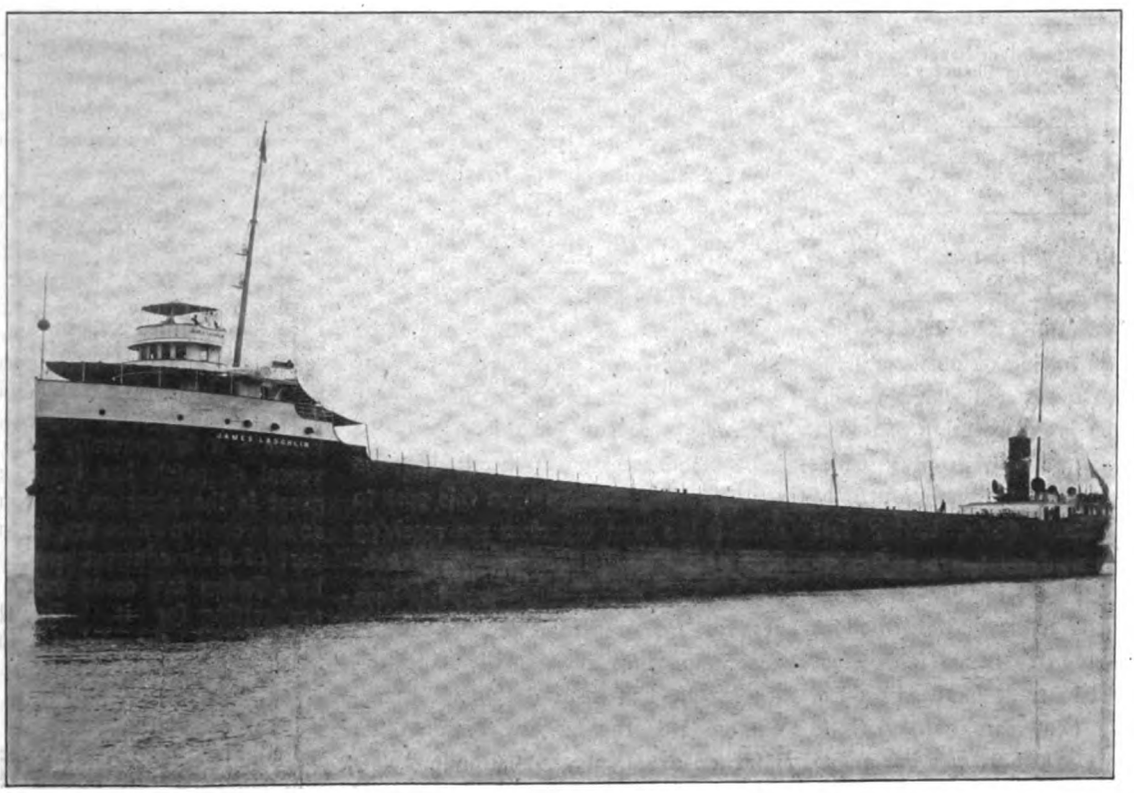
William Millington, of Erie, Pa., who is chief engineer of the new steamer James Laughlin, has been in the business twelve years. He started oiling on the package freighter Susquehanna and began a chief's career on the old Gordon Campbell. He brought out the steamer Sylvania last year, and had the same distinction with the Laughlin this year.

A feature of the after end is that coffee served at midnight when the after watch comes on is kept hot with a special heater in the mess room instead of on the stove in the galley. The galley is presided over by Mr. Irvine Young, with Mr. Robert Baff and Mr. Geo. Ambuster as his assistants. There is a passengers' dining room as well as a crew's. Each one is fitted with electric fans.

Chief Engineer William Millington, of Erie, looks after the engines, assisted by Mr. Charles Culver and Charles Draper, first and second assistants. The engine room is complete in every way. The vertical and rotary pumps can fill and empty the tanks of 6,000 tons of water in five hours. Capt. Hill, shore engineer, has installed steam pipes behind the oil tanks for cold weather. The Laughlin runs 11½ miles loaded and 13½ light.

Capt. Symes is a young man and it is noteworthy that all the members of the crew are also young. Mr. S. H. Smith is his mate, and Mr. F. E. Dana his second mate.

On the last trip up the Laughlin carried the following passengers: Mr. and Mrs. W. J. Lightner and Miss Marjorie Lightner, Mr. and Mrs. John Ommert and Miss Estelle Ommert, and Mr. W. J. Creighton, all of Pittsburg. Mr. Lightner and Mr. Creighton are connected with the Jones & Laughlin office.



NEW STEAMER JAMES LAUGHLIN.

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THE MARINE REVIEW

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LAKE ERIE TERMINALS.

The railways having terminals at Lake Erie ports are confronted with a serious problem. They are discovering that their slips and docks are daily growing inadequate to accommodate the growth of lake trade. Some docks, having fast and expensive equipment, are non-existent in so far as the large carrier is concerned—that is to say, the modern steamer cannot go to them. This great revolution in lake trade has been sudden. It is scarcely two years old. A little over two years ago there was not a ship on the lakes 500 ft. long. Today there is scarcely a ship under contract as small as that. No business in this country is conducted with greater boldness and originality than the vessel trade of the great lakes. When, in the evolution of unloading, a type of dock machine was devised that could with greater efficiency operate in a ship of modified form of construction, vessel owners had not the slightest hesitancy in adopting an altered type of construction. Thus, the ship was molded to meet the new conditions on the docks. The docks themselves will now have to be reconstructed to meet the altered conditions brought about by the modern carrier. The railways will doubtless be as bold as the ship owners. Millions will be expended at Lake Erie terminals in the next few years to meet the changed conditions under which lake trade is now conducted. The lake cities have been enjoying a period of unexampled prosperity, and if signs fail not, it is a prosperity which will pursue an ascending scale for several years to come.

If anyone wants to see the American flag flying at the stern of a steamer, he must come to the great lakes; if any young man desires to become master of an American vessel, he must come to the great lakes. In a practical sense, there are no American vessels in oversea trade. This condition will continue as long as congress is indifferent to the crying needs of our oversea shipping. It is unfair to protect all industries and leave one exempt. That is the relation which oversea shipping bears to the settled policy of the United States. Either remove the tariff or protect the ship.

ASHTABULA EDITION.

The MARINE REVIEW will in one of its September issues present the port of Ashtabula exhaustively to the public. There is a reason for this. Both the Lake Shore and Pennsylvania railways are expending millions upon this port to make it the most capacious ore receiving port on the lakes. The growth of Ashtabula as an ore receiving port has been steady. From an inlet capable only of accommodating very small schooners, its harbor has been developed to accommodate the largest vessels that float or are likely to be built. This remarkable evolution is worthy of careful chronicling. The MARINE REVIEW'S Ashtabula edition will, from its historical accuracy and pictorial excellence, be well worth preserving.

It appears that the strictures of some of the Pittsburg Steamship Co.'s captains upon the manner in which a number of the line boats are operated has created much discussion. It appears also that the captains maintain that they were mild in their remarks upon the subject and that actual conditions call for more violent language. On the other hand, line managers maintain that they are sincere in the instructions given to their captains to check during fog, and would esteem it as a favor if any of the offending vessels are pointed out. One thing is certain,—the line boats check or do not check.

FREIGHT SITUATION.

These are certainly days on the lakes when vessel owners have cause to rejoice that they are vessel owners. Likewise, owners of iron mines have cause to rejoice that they are iron mine owners. They are literally sitting back in their chairs, saying that they have nothing for sale and no tonnage to offer. Last week a furnace man called up one of the ore producing interests and asked for 30,000 tons of ore. The company was unable to give it to them, and he gradually lessened his demand until he finally pleaded for a small cargo of 3,000 tons. Even this was not promised, as the company is behind in its own shipments and has vainly sought for tonnage for several days past. This is not an individual case, but has been a more or less common occurrence during the past few weeks.

The vessel tonnage on the lakes is greater by from 3,000,000 to 4,000,000 tons this year than ever before. Ore shipments to Aug. 1, however, were only 900,000 tons greater than for the corresponding period last year, showing that ore has not moved in a corresponding ratio of increase. The difficulty has been in getting it to upper lake docks, because it is generally admitted that vessel despatch has been good. So great is the pressure for tonnage that some vessel owners are trying to shift part of their contract ore upon others by offering five cents more than they are getting for it. In the whole history of the lakes there has really been no season like the present. Three or four years ago these self-same conditions would have resulted in daily fights between owners and shippers, one bulling the freight rate and the other bearing it. Today, vessel owners are generally content with the situation and are trying to keep the market steady. The general trade has undergone such evolution that the interest of one has become the interest of both. The advance in the coal rate has not perceptibly stimulated offerings, proving again that the ships are so generally employed that

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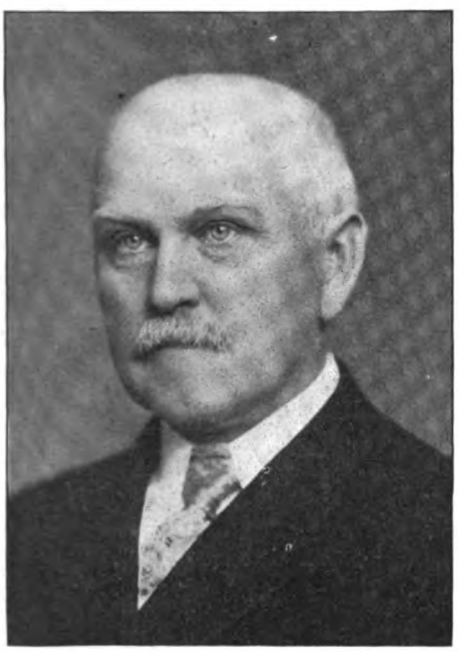
there is little tonnage to be had. Congestion has existed in upper lake coal docks. Thirty-eight coal carriers were bunched at one time in the Duluth-Superior harbor last week.

The grain rate has further advanced, two cents being paid from Chicago. If reports of an extended crop are true, this rate will have a brilliant finish.

EUGENE ELWIN HASKELL.

Eugene Elwin Haskell, who was recently elected director of the College of Engineering of Cornell University, and has also just been appointed by President Roosevelt a member of the American section of the International Waterways Commission, vice the late



MR. EUGENE ELWIN HASKELL.

George Y. Wisner, has had the following large experience in his chosen calling which justifies his selection for the new responsibilities.

Immediately after graduating as a civil engineer from Cornell in 1879, Mr. Haskell's first service was with the lake survey, which at that time was just closing up the field operations connected with a comprehensive survey of the great lakes for chart purposes. The following year he became connected with the Mississippi River Commission, having headquarters at St. Louis, Mo., and spent the next five years on surveys and hydraulic investigations of the Mississippi river.

His next activities, starting in 1885, were with the United States coast Geodetic Survey, and for the ensuing eight years he was engaged in hydraulic research, chiefly in relation with the tides and currents of New York harbor, the erosion of the Cape Cod coast of Massachusetts by the sea, currents and temperatures of the gulf stream off the coast of Florida and in the Gulf of Mexico, and circulation of the sea through Long Island Sound.

In 1893 the late Gen. O. M. Poe secured Mr. Haskell's services for the reorganization of the lake survey, with which he has since been identified, serving as principal assistant engineer under Maj. W. L. Fisk, Maj. J. L. Lusk, and Col. G. J. Lydecker, officers of the corps of engineers having general charge of the survey. In this latter capacity, Mr. Haskell has had immediate supervision of the work of making surveys for purposes of chart construction, and has also conducted an investigation of the cause and effect of lake level fluctuations. His intimate acquaintance with this latter subject, coupled with his expert knowledge on matters pertaining to the flow of water in open channels, will be of especial value in the solution of the problems which the International Waterways Commission was created to consider.

Mr. Haskell will take up his residence at Ithaca and assume the duties of his professorship about Sept. 1. He has ever been mindful of the interests of Cornell, having been instrumental in the formation and serving as first president of the Detroit Cornell Alumnae Association, and his call to the university as director of one of her important branches is a fitting tribute to his ability, as well as a pleasing token of appreciation of his efforts for the welfare of his alma mater.

ORE SHIPMENTS.

Duluth, Aug. 13, 1906.—From Aug. 1 and including Aug. 7 the total ore shipments from the three ports at the head of the lakes were 844,403 tons as compared with 736,063 tons during the corresponding week in 1905. This makes the total up to Aug. 7 this year 12,313,600 tons, an increase of 1,176,177 tons over last season's shipments to this date. The record of the separate ports is as follows: Two Harbors, 248,962; Duluth, 393,144; Superior, 202,297 tons, a total of 844,403 tons. For the corresponding period last year the shipments were Two Harbors, 275,296 tons; Duluth, 282,837 tons; Superior, 177,403 tons, an aggregate of 736,063 tons or 108,340 tons less than this year.

AROUND THE GREAT LAKES.

The steamer Norman B. Ream, building at the South Chicago yard of the American Ship Building Co., for the Pittsburg Steamship Co., will be launched at noon Saturday.

The barge Katahdin wrecked the Brown hoists at the B. & O. docks at Lorain this week and was attached by the sheriff of Lorain, under orders of the Cleveland, Lorain & Wheeling Railroad Co.

The striking cooks on the tugs of the Union Towing & Wrecking Co., of Duluth, have returned to work. They struck for an advance of $10 a month in their wages and were offered $5, which they accepted, making their wages $145 a month.

The first of the 605 footers, which is building at the Lorain yard of the American Ship Building Co., for W. M. Mills, of North Tonawanda, will be named William B. Kerr in honor of the superintendent of the Tonawanda Iron & Steel Co.

Mr. C. E. Askew, who has for several years been employed by M. A. Hanna & Co., has been promoted to the position of master mechanic of the company's shops in Buffalo, with supervision over all mechanical work on the docks at that place.

The steamer Edward Y. Townsend, building for the Cambria Steel Co. at the Superior yard of the American Ship Building Co., will be launched on Saturday. The steamer Daniel J. Morrell, building at the Bay City yard of the American Ship Building Co. for the Cambria Steel Co., will be launched on Wednesday.

When the steamer James Laughlin left Ashtabula Monday afternoon, she had the following passengers aboard: Mrs. Geo. A. Symes, wife of the captain; Misses Rolla New, Nora New, Leila Leach and Rylis Leach, all of Cleveland, and Mrs. G. A. Houghten, Misses Abbie and Glaydis Houghten and Mr. Rufus Houghten, of Andover, O.

The steamer Pontiac, commanded by Capt. C. R. Ney, recently made a trip from Cleveland to Marquette and back in five days and three hours, loaded one way. The Pontiac runs 14½ miles light and 12 miles strong loaded. Wm. T. Mooney is her mate; A. G. Hill, second mate; Jos. Jennerson, chief engineer, and Edward Graves, second engineer. The Pontiac broke her wheel at Ashtabula and was towed to Cleveland for repairs, Monday.

That the skippers of lake freighters are thoughtful in the extreme of the comfort and pleasure of others was evidenced at Ashtabula this week when a Pittsburg Steamship Co. captain accidentally let it out that he throws off magazines and papers to the government men stationed in the Soo river in the patrol service. It is understood the recipients greatly appreciate this, because they are too far away to keep in close touch with affairs.

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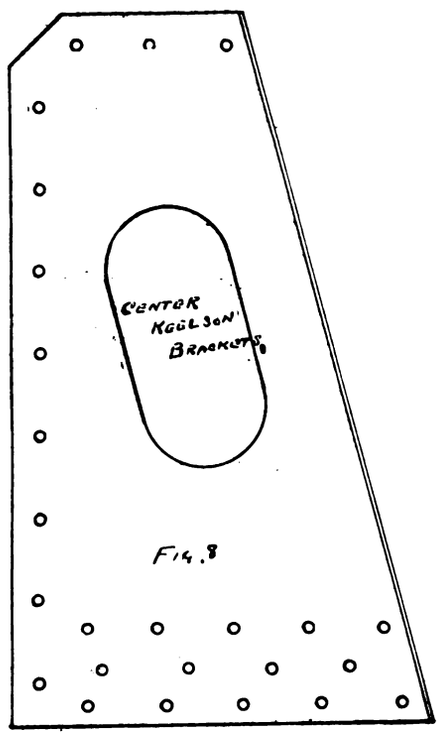
LAKE SHIP YARD METHODS OF STEEL SHIP CONSTRUCTION.

BY ROBERT CURR.

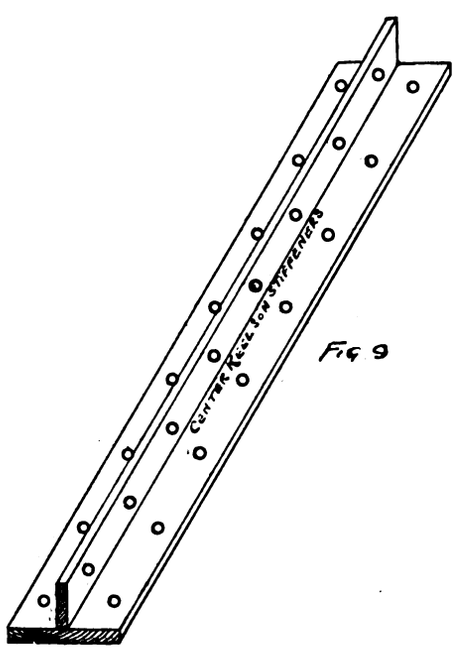
MOLDS.

Fig. 8 shows mold made ready for marking the bracket plates for the center keelson.

This bracket connects the channel



floor to the center keelson, being fitted to the center keelson with double angles. This mold will do for all the brackets on the center keelson which are fitted where there are no solid

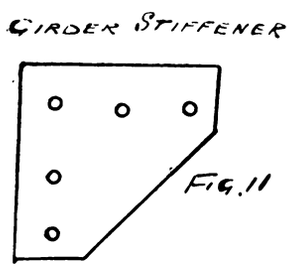


floors, as shown by bulkheads and belt frame floors.

Fig. 9 shows mold for center keelson bracket angles. This mold is made tee shape so that right and left angles can be marked from same. There are four angles for each frame, including deep floors, but not bulkheads. The bulkhead holes are closer for watertight riveting and are taken care of with the smithwork molds,

Fig. 10 shows mold for girder stiffeners. A mold is made for each girder because the rise of floor and the drooping of the tank top at sides, shortens the stiffeners towards the ship's side. This mold is made tee shape in order to get an angle for each side of the vessel, or a right and left.

Fig. 11 shows mold for bracket



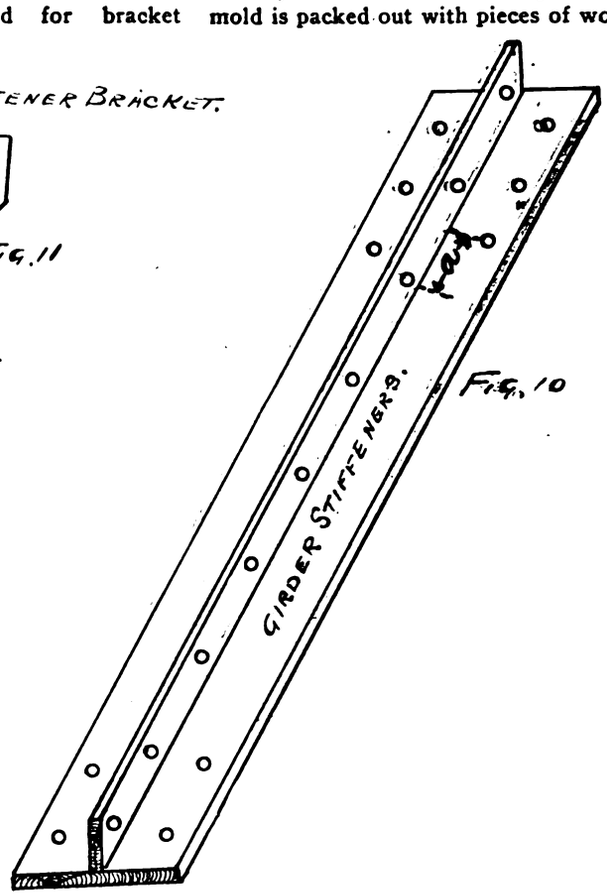
plate, which is suitable for all the girders throughout the vessel. Six brackets are made from each mold for each frame clear of the deep floors and bulkheads.

In the case of the girder angles, Fig. 10, at the ends where the depth becomes less, the mold is drawn together at "a" to suit the difference, which will close up the pitch of the two holes at either side of "a." This enables them to mark all the girder stiffeners for each girder from the one mold made for same.

On the deep floors the girder stiffeners become corner angles, also the girder next the bilge, seeing the bilge bracket connects to the fourth girder. In that case the angles are 3½ x 3½ inches and as the rivet hole spacing is eight diameters on each flange, molds are made to suit each girder depth.

Fig. 12 shows mold for bilge brackets which is used for 85 per cent of the vessel; beyond that, at both ends, molds are made for each bracket. Two plates are obtained from each mold at the ends beyond midship.

Fig. 13 shows the mold for the channel frames at side. "b" shows the mold used for marking the shell holes. This strip is held at the deck line or top of frame and fastened on to the shell flange with slips until it reaches the outside shell plate on the bilge. In way of the outside shell plate the mold is packed out with pieces of wood



the thickness of the inside bilge plates, "d" Fig. 15.

This method of making an allowance for the outside bilge plate facilitates the arrangement of rivet holes around the bilge and keeps a uniform pitch throughout the vessel. This mold carries the work on throughout the square body and at the ends for some distance. Molds are made for the two bilge strakes only until the frames become almost straight at the bilge, when new molds are made for the shell holes. The butt holes at "C" connect on to the channel floor C1, Fig. 14, Figs. 13 and 14 forming the frame and floor, making one piece from the spar deck to the keel when riveted together.

The marks "aaa" show the holes for the side channel stringers. These

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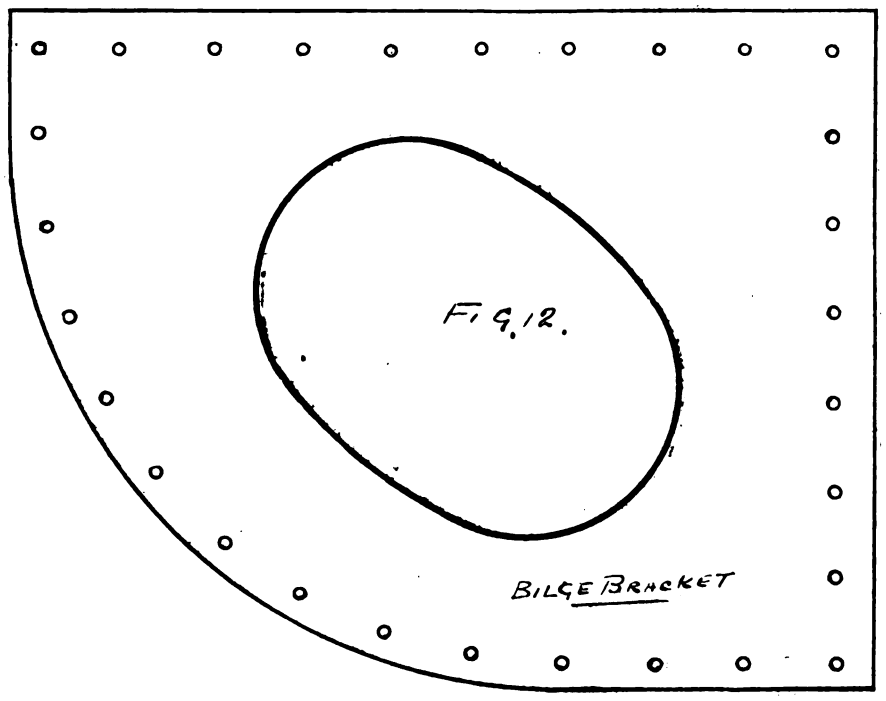
marks of the mold are squared over on to the inside flange of the channel frame and from the heel of the frame the distance is measured for the center of the hole as shown at "a" Fig. 14a.



mark being squared over from the mold to the flange of the channel floor and from the heel of the channel the center of the hole is measured "a" Fig. 14a, care being taken that not

out at this part and the holes marked through. In this case it saves any mix-up in changing the holes from the mold which is used for marking the frames.

Fig. 16 shows tank top angle. This angle is fastened on to the girder stiffeners by means of the brackets shown by Fig. 11. A mold is made for the flange that is connected to the girder stiffeners and bilge brackets and another mold representing the tank top as shown by the greatest number of holes.

This angle on the deep floor or belt frame is punched more alike on both flanges for the riveting to the floor plate.

It will be noticed the molds show only the bracket holes on the four-inch flange, this tank top angle being fitted on the main frame clear of the belt frames.

Fig. 17 shows the main deck stringer beam plate. This plate is fitted under the main deck stringer on every frame in the side tank, the one mold being suitable for all the brackets. The strip on top shows the piece for the flange rivet holes to the stringer plate.

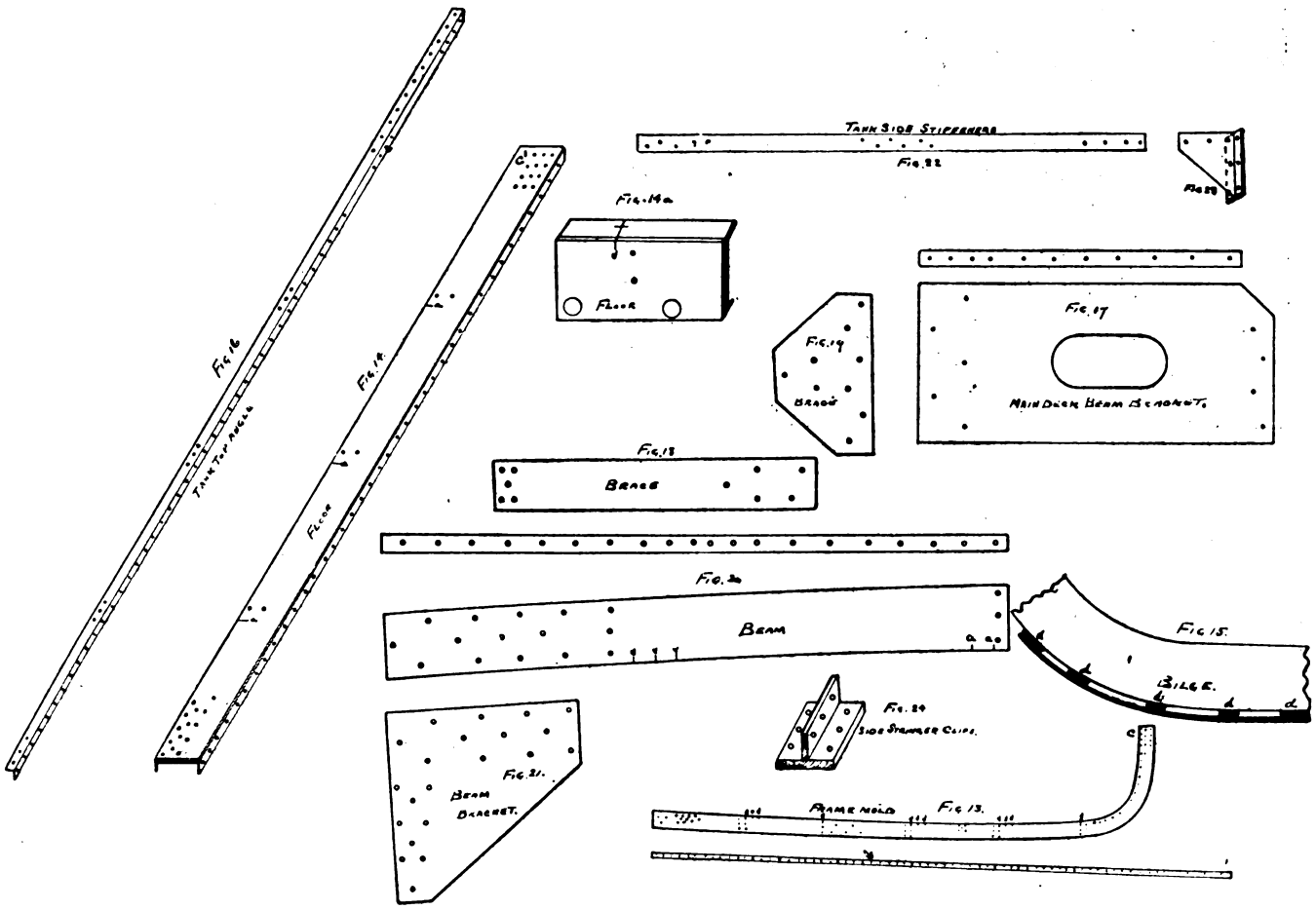


Fig. 14 shows the channel floor molds, one mold for the web and another for the shell holes. The holes for the girder angles on top of the channel floors are marked "a," this

less than the diameter of the hole remains from the edge of the flange to rivet hole.

Fig. 15 shows the bilge outside plate. The mold for the shell holes is packed

This plate is flanged top and bottom.

Fig. 18 shows mold for channel brace between tank top and main deck stringer in side tank and Fig. 19 shows bracket plate for same, which are

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same throughout tank side, the two molds being suitable for the braces throughout the tank side.

Fig. 20 shows the channel spar deck beam mold, "aaa" are the rivet holes for the channel ties under the beams which are squared over same as the frame and floor holes for channels and angles on inner flanges, the narrow strip is for the deck stringer holes.

Fig. 21 shows the spar deck beam bracket mold. All these beams and brackets are laid off for 85 per cent of the vessel before any change is made on same.

Fig. 22 shows mold for tank at side stiffeners and Fig. 23 shows mold for bracket plates for same, which are flanged and connected to the tank top angle.

Fig. 24 shows mold for stringer, channel clips at side and all channel ties throughout the vessel.

The license of Capt. J. T. Linnon, master steamer Holland, which was recently revoked for the failure to report the sinking of the Holland in Duluth harbor by the shifting of her deck load of lumber has been restored upon order of Supervising Inspector Sloan. It developed that he was not required to report an accident of this nature.

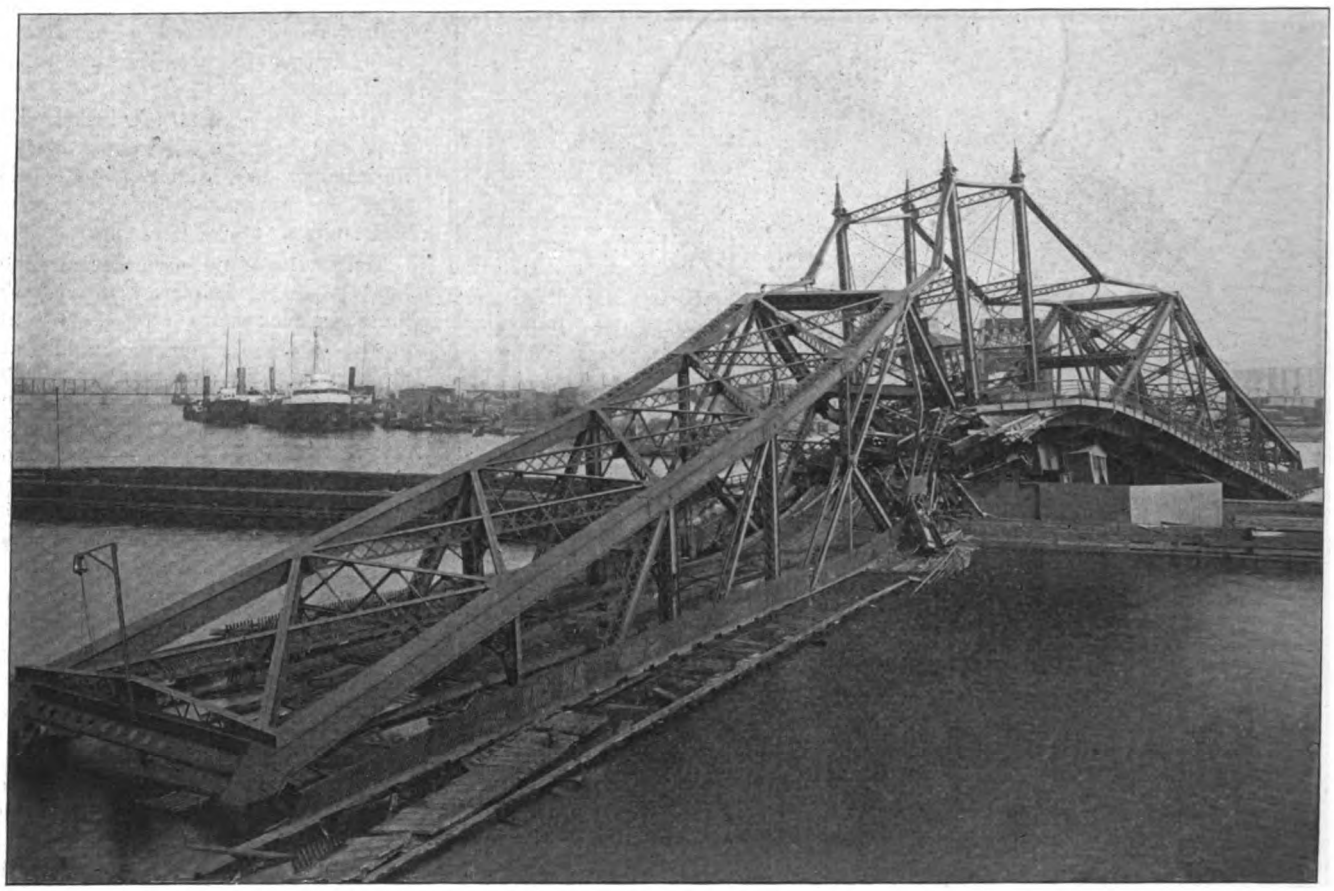
THE INTERSTATE BRIDGE AT DULUTH WRECKED.

Since 1 o'clock Saturday morning traffic to all points in the river at Duluth has been blocked and as many as 33 boats have been tied up in the inner harbor unable to get out. At the time mentioned the 5,000-ton steel package freighter Troy of the Western Transit Co. line, Capt. Robert Murray, moving from the bay up into the river, collided with the opening draw and so wrecked it that it lay across the channel, as shown in the accompanying illustration, almost completely blocking the passage. This means a tying up of the Missabe ore docks, nine of the coal docks, the Globe and Great Northern grain elevators, the Zenith furnace and other interests. Several lumber boats caught inside made no attempt to get away Saturday, but it developed Sunday that boats of not more than 37 ft. beam could, with some assistance from tugs, squeeze through, and the Niko, Sachem, Edward Hines, Leuty, Lindsey, Geo. B. Owen, Kalkaska, Peterson, Fryer, Pridgeon and Case escaped. Fortunately there were practically no loaded boats at the Missabe docks at the time and in addition there were several unloading coal in the inner harbor, which boats will be sent to the Missabe docks to load, so that the dock will not be congested so seriously as might have been.

There is as usual a difference of testimony as to the circumstances and causes of the accident sufficient to make the placing of the blame uncertain as yet, but an investigation has already been started. Capt. Murray of the Troy said in reference to the collision:

"When the bridge did not open fast I was not much alarmed for it is almost the inevitable case that the bridge does not open until vessels are close upon it. I think almost every captain that makes this harbor will back up that statement. It was just about 1 o'clock this morning when the accident happened. At the turn just the other side of the Peavey elevator, I whistled for the bridge. That is the customary place. The light from the bridge kind of blinds one at night, and for a short time I could not see whether or not the bridge was swinging. When I at last saw that it was not, I did not think much of it, as I have said, for that seems to always be the custom of the bridge operators. However, when I got uncomfortably close to the bridge and saw that it was not swinging, I blew alarm signals and backed at full speed.

"On approaching the bridge I was



WRECK OF THE INTERSTATE BRIDGE AT DULUTH.

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going only four miles an hour or thereabouts and had I had a little more time, I might have checked up more. As it was the only result the backing had was to swing my stern to port. Of course I could do nothing else but back, but it availed me nothing. Had I gone ahead I suppose I would have hit the end of the bridge and helped push it open, but the backing, as I say, swung the stern to port, and I hit the bridge in the middle. Then the crash came.

"I and other captains have long expected some accident of this sort because of the manner which has been in force of opening the bridge only at the last minute; but I regret deeply that it fell to my lot to be the victim.

"There has been one shortcoming of the bridge ever since it was built and that was the lack of signals on it. The operator has no means of letting a master know if he could or could not open the bridge and we had to go ahead and take our chances. I complained to our agent about this once, and he said he would take the matter up. Mr. Douglas was on the Buffalo with me one day when the bridge was excessively slow in opening and he was very much alarmed for a time. I pointed out the lack of signals and he said that he would take the matter up, but nothing came of it.

"My opinion is that the operator was asleep."

On the other hand the bridge tender claims that the Troy was only 600 feet away when she blew the signal and was coming at the rate of eight miles an hour, instead of four. D. M. Philbin, assistant general manager of the Great Northern railroad, whose property the bridge is, was of the opinion that at 1 o'clock, which is the time at which the draw is always swung open for the remainder of the night, the bridge operator would be less liable to be negligent than at any other time. The excellent past record of both the ship master and the bridge master makes the occurrence the more unaccountable.

The draw was about one-third open when hit and the steamer struck close in toward the middle. The force of the blow moved the bridge but little from its natural position on the bearing on which the rollers supporting the draw run, but the shock swayed the structure so that a diagonal strain resulting from the overhanging ends came on the long compression columns in the center. All four columns buckled, bending at right angles in two places, letting the top down ten feet and taking the tension off the two ends, which sank in the channel on both sides, the bottom chord on the side that was struck breaking off clean. The loss to the Great Northern in damage to the bridge has not yet been estimated, but it is believed that it cannot be rebuilt before the opening of navigation next spring. As much of the wrecked span will be saved as is possible, but the woodwork is entirely splintered in the center and the two middle panels are bent and broken beyond redemption.

Immediate measures were taken to remove the obstruction, and after a consultation of engineers and others, including President Harry Coulby, of the Pittsburg Steamship Co., who had just arrived in the city, and Engineer Hoagland, of the Great Northern, it was decided to lift the span adjoining the draw away, which will open an old channel 230 ft. wide and 20 ft. deep. Scows will be filled with water under each end of the span to be removed and then they will be pumped out, lifting the bridge bodily and towing it into one of the slips until the wreckage can be removed. It is expected that Whitney Bros., of Superior, to whom the contract was awarded, will have that work done by Tuesday night at least. A dozen or more boats are anchored in the outer harbor awaiting the opening of the channel. Several of the boats coming up light were ordered to Superior, Two Harbors and Ashland, but most of them are loaded with coal, which fact will result in a second congestion and delay in unloading.

The Interstate bridge was built in 1896 and opened in 1897. It is the connecting link between Duluth and Superior and traffic between the two cities is considerably hampered. The steamer Troy was scarcely damaged at all and will clear for her down trip.

A small hole not over two feet in diameter is punctured in the forward part of her bow about three feet above the hawse pipe on her starboard side, and the anchor in her port hawse pipe is snapped off short. That is the total damage to the boat, beyond having the paint scratched off in one or two places on the bow.

AT THE HEAD OF THE LAKES.

Duluth, Aug. 13.—The coal situation at the head of the lakes is not badly crowded as yet. All of the docks have been able to take care of the boats so far as storage is concerned up to this time, but the docks are making strenuous efforts to get the movement of coal into the interior started for the assurance of a greater shortage of cars than ever before experienced seems everywhere evident and is confidently believed in. At the present writing the Northwestern Fuel Co. has three boats at its Duluth dock, two at No. 1 and two waiting, and two at No. 3. The No. 4 dock is not filled, but in all there are 58,000 tons of coal unloading or waiting to unload at the Northwestern docks. The Pittsburg Coal Co. has three boats at its No. 1 dock and one at No. 2. The St. Paul & Western Coal Co. has two boats, but the Lehigh have none in at the Superior dock and none reported, though there is one boat at the Duluth dock of this company. The other docks in the inner harbor are pretty much open because the boats that were unloading at the end of the week are now at the Missabe docks loading ore and no others can get in. The dozen coal-laden boats now waiting for the channel to be cleared will probably meet with considerable delay.

The coal dock people do not feel that the rush of coal is more than is to be expected or more than will have to be shipped regularly in order to get the required amount up here. Ore interests depending upon wild cargoes for the carrying of their tonnage are objecting to putting so many boats in coal on the up-trip because of the slower time and possible delays. A great deal of coal, however, must be moved during the short lull in the grain trade and from the coal handlers' standpoint at least it seems necessary to put every boat possible in coal at present. A little later it is expected that the present 40-cent rate will be raised, but that will depend somewhat on how rapidly the coal can be moved away from the docks, a movement which is very uncertain as yet. From August 1 to August 12, 368,161 tons of coal were received at Duluth, Superior and Two Harbors, which is not at a rate any more rapid than the receipts in July, when 840,269 tons were received.

The week was normally quiet in grain, most of what still remains at the head of the lakes being easily taken care of. The receipts and shipments are as follows. The rate remains at 2½ cents and 3½ cents for October shipment.

	Receipts.		Shipments.	
	Aug. 4.	Aug. 11.	Aug. 4.	Aug. 11.
Wheat	244,691	186,726	756,077	373,899
Corn	3,923	3,973	34,057	....
Oats	253,399	164,784	524,672	335,953
Barley	144,168	157,248	142,679	210,696
Rye	17,782	15,284	1,343	....
Flaxseed	428,377	251,235	635,346	662,900

Wm. Heller, now second mate on the B. Lyman Smith, is to be given a mate's berth on that boat when Geo. L. Phillips goes on the Joshua Rhodes. Ellroy Fisher, now wheeling on the Smith, will be pushed up a notch to a second mate's berth with Heller. Capt. Frank Boyer is master of the Smith.

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SCIENTIFIC LAKE NAVIGATION

By Clarence E. Long

THE DIRECTION OF THE FORCE OF TERRESTRIAL MAGNETISM.

This is estimated in two co-ordinate planes, the one horizontal, the other vertical; the former of which the geographical meridian is taken as the initial line. It is measured by the direction of the magnetic needle suspended to move in each of these planes. The needle hung so as to move in the horizontal plane is called the "Declination" or "Variation Needle;" that hung so as to move in the vertical plane the "Inclination" or "Dipping Needle."

To recapitulate: The needle of the mariner's compass moves in the horizontal plane, and receives its directive force from the magnetic poles of the earth. The dipping needle moves in the vertical plane, and this is controlled by the earth's line on force, or the earth's vertical magnetic force, which varies at different places upon the earth's surface. The earth has no vertical force on the magnetic equator, and at all places on this line the dipping needle takes a true horizontal position; or in other words the dip is zero. At the magnetic poles of the earth the dipping needle points vertically downwards, or in other words, the dip is 90°. If the dipping needle is carried toward the equator from either magnetic pole of the earth it will gradually approach a horizontal position until the magnetic equator is reached, when a true horizontal position is attained.

DIPPING NEEDLE.

A magnetic needle suspended at its center of gravity so as to move freely from the horizontal to the perpendicular.

A property belonging to the magnetic needle, whereby one of the poles (ends) inclines toward the earth, while the other is repelled or elevated. Now, what is meant by the earth's line of force? It is the position which a freely suspended needle moving in a vertical plane, and undisturbed by iron, would take up if left entirely to itself. In the first place it would point toward the magnetic pole, and in the second place, one end would incline downwards at an angle below the horizontal corresponding to the "dip" at the place, the needle being horizontal at the magnetic equator and vertical at the magnetic poles. The line of force at any place is the line of dip at that place, and is the most favorable position in which a soft iron bar can be placed to receive induced magnetism from the earth. A soft iron bar placed lengthwise in the line of force or held horizontally in a north or south direction receives induced magnetism instantly, but parts with it quickly if it be held in an east and west direction at right angles to the magnetic meridian. Hard iron requires a longer time to receive magnetism by induction, and does not part with it so soon; it may even retain a part of its magnetism permanently.

EFFECT OF VERTICAL IRON.

In north magnetic latitude the upper end of vertical soft iron will attract the north pole of a magnetic needle held near it; on the other hand, in south magnetic latitude the upper end of vertical soft iron will attract the south pole of the needle, and repel the pole of the needle it has previously attracted. On the magnetic equator vertical soft iron has no effect because its position is at right angles to the line of force.

RED AND BLUE POLARITY.

There is some confusion in writers on the subject on this point. If the north pointing pole of the compass needle is attracted by magnetism residing in the north magnetic pole of the earth, the law of attraction (that unlike poles attract) shows us that these two poles are really magnetically of opposite kinds. If we call that north magnetism which is at the north pole of the earth, we must say that the north-seeking end of the compass needle contains south magnetism. And if we call that north magnetism which points to the north, then we must suppose the magnetic pole at the north pole of the earth to have south magnetism in it. This being the case, it is found convenient to distinguish them by color, calling the north-seeking end of the needle red or north polarity, and the north magnetic pole of the earth blue or south polarity. The south magnetic pole of the earth contains red or north polarity and the south end of the compass needle blue or south polarity.

At the north magnetic pole, the red, or north end, and at the south magnetic pole, the blue or south end of a freely suspended needle points vertically downwards, or the dip is 90° at both these places. This being true, the northern hemisphere, that is, north of the magnetic equator, is composed of blue polarity or south magnetism; and the southern hemisphere, south of the magnetic equator, is composed of red polarity or north magnetism; and the earth's line of force varies between a true horizontal line and a true perpindicular line. Between the parallels of 40° north and 50° north latitude (the region of the great lakes) the dip, or earth's line of force, is between 73° and 77°; that is, the dipping needle dips that much from a horizontal line, and whatever this angle is, represents the earth's line of force.

For experimental purposes the two ends of the magnet are painted red and blue—red for north and blue for south; the red and blue colors meet at the center of equator of the magnet. As we have just seen, the earth's vertical force is greatest at the poles and nothing on the magnetic equator. Just the opposite effect takes place relative to the horizontal force of the earth, it being greatest near the magnetic equator and nothing at the magnetic poles. At the earth's magnetic poles all compass action ceases, since there a freely suspended needle pointing straight up and down, has no horizontal force to give it direction, hence, the very apparent sluggishness in the area of the magnetic poles, and were it not for the conical shape of the pivot and cap which compels the card of a mariner's compass to assume, or very nearly so, a horizontal position, it would tip over and jam against the glass cover as the magnetic poles were approached. For this reason, a liquid compass is of no use in high latitudes, and instead a dry compass is employed, the dip being counteracted by attaching a weight on the south end of the compass card in north latitude and vice versa in south latitude. From what has already been said, one would imagine that at the magnetic equator would be found the strongest lines of horizontal or directive force; but most careful observations prove that such is not the case, in fact, that of the two they rather evince a preference to the geographical equator. This is another unknown law. Neither does the greatest vertical force exist at or over the magnetic poles. This maximum force is near, but not at the poles—another law that cannot be accounted for.

Remember, that near the magnetic equator the compass will show the greatest number of vibrations (swinging of the card to and fro) in a given number of seconds. This is the manner in which magnetic force is measured. The farther you go north or south from the equator, the less number of vibrations will the compass needle show in the same length of time. The dipping needle shows the greatest number of vibrations

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in the vicinity of the magnetic poles and nothing at the equator.

Whatever the process of magnetization may be, it produces two opposite and equal forces (this is not always a fact, but it may be assumed as such) in the ends of the steel bar, from which it follows that there will be a neutral point about the center of the bar totally devoid of magnetism of any kind. It is well to know this, since, if it be compulsory to put a compass near vertical iron it may be possible to raise or lower it to the level of the neutral point, and so render the iron incapable of mischief, so long as the ship remains upright.

Note.—A great many marine men have an idea that because the compass needle points toward the north, that that end of the needle has more magnetism than the other end. This is absurd. There is an equal amount in each end and the south magnetic pole of the earth has as much influence in giving the compass needle its directive force as does the north magnetic pole of the earth. The north magnetic pole contains the blue polarity, which attracts the north or red end of the compass needle, and the south magnetic pole containing red polarity, attracts the south, or blue end of the compass needle; so that it makes no difference which part of the world we are in these poles gives the magnetic needle its pointing power. Anywhere between the two magnetic poles—south of the north magnetic pole and north of the south magnetic pole—the north end of the compass needle points to the north magnetic pole and the south end to the south magnetic pole. North of the north magnetic pole the north end of the compass needle points south, but notwithstanding, the north end of the compass needle continues to point to the north magnetic pole of the earth, being between the magnetic and true poles of the earth. Just the opposite conditions prevail south of the south magnetic pole, the south end of the compass needle points north, since the south end in pointing to the south magnetic pole must swing entirely round when the magnetic pole is passed.

THE DIFFERENCE BETWEEN HARD STEEL AND SOFT IRON.

The next most important point to be remembered is the difference between a magnet made of hard steel and one made of soft iron. That of hard steel will not reverse its poles, no matter at what part of the earth, or in what position it may be held. Its magnetic character is absolutely permanent, and will so remain even though its red end be directed towards the south, and its blue end towards the north. Hard steel displays no particular haste to receive magnetism, but once acquired, it does not like to part with it. Not so, however, with soft iron, which possesses no independent magnetism of its own. In its case the magnetism is of a purely transient kind, ceasing with a removal of the producing cause, and being just as easily and quickly reproduced with reversed poles in the same bar.

The experiment may be easily tried with an ordinary kitchen poker and a boat's compass. But, first, it will be necessary to explain that a bar of soft iron, if held in the earth's line of force, will instantly become magnetic, though it may not have been so before.

The dip at South Chicago is about 73°. When, accordingly, the poker is held in this direction, it at once becomes magnetic by induction—its lower end or point, acquiring red magnetism in our hemisphere, and its upper end or handle, acquiring blue magnetism. This may readily be tested by placing the compass near it. If held a few inches from the lower or red end, the south point of the needle will be attracted by the poker, while, if held near the upper or blue end, the north point of the needle will be attracted. This invisible force, exerted by the poker, is termed "induced magnetism" or "magnetism of position" and only remains so as long as the poker is held in that particular manner. To destroy it, it is merely necessary to hold the poker in an east and west direction, or at right angles to the line of force, when it will no longer appreciably affect the compass. Be careful not to get the end of the poker too close to the compass needle or the needle will induce magnetism into that end of the poker, and only attraction will take place.

This shows that soft iron has no fixed polarity, but that on the contrary, it retains magnetism only precariously, and easily loses it when mechanically disturbed. For example, percussion exercises a marked influence on both the inducing and dispelling of this kind of magnetism. If, therefore, the poker be hit a few taps with a hammer whilst held in the line of force, its magnetic power will be intensified; and, again, when the position is altered so as to dissipate the force, it will be found that the tapping hastens that process also.

Let the poker be once more held in line of force, but this time with the point up and handle down—it will again become magnetic; but the blue and red magnetism will be found to have changed ends. The red will have shifted its quarters to the handle, because it is now the lower end, and the blue to the point, because it is now the upper end. Just like water and oil behave in a bottle; the oil will unfailingly be found at the top, no matter which way the bottle may be held.

The facility with which soft iron acquires or parts with magnetism may be shown in another way. Take the kitchen poker, in imagination, to the north magnetic pole, and hold it vertically point down. The lower end, as before, will acquire red and the upper end blue magnetism. Holding it still in the same way, transport it to the magnetic equator; it will there be entirely free from magnetism of any description. Still holding it in the same manner, transfer it to the south magnetic pole, it will once more be magnetic, but the lower end will now have blue and the upper end, or handle, red magnetism. The rapidity of the change will correspond to the time occupied on the journey. As before stated, this will not happen with a magnet of hard steel, whose poles remain unchanged in character, no matter which way it is held, or in what hemisphere it may be placed. Keep this in mind, as it bears directly upon the behavior of the iron in a ship.

Thus, in north (magnetic) latitude the upper end of all vertical soft iron, such as funnels, masts, stanchions, davits, rudder, sternpost, etc., has blue magnetism and attracts the north end of the compass needle; while as the ship sails south such iron becomes gradually weaker in its effect, and on the magnetic equator, being then at right angles to the line of force, produces none whatever. On the other hand in south (magnetic) latitude, the upper end of this same vertical iron acquired red magnetism, and repels the end of the needle it had previously attracted, doing so with continually augmented force as high latitudes are gained.

Further, be it remembered, that in any given latitude the magnetic intensity of a vertical bar of soft iron, such as the rudderpost, remains undiminished, no matter what may be the direction of the ship's head; but its disturbing effect on the compass depends upon its position relative to the needle, being greatest when at right angles to the direction of the needle's length, and ceasing when in a line with it. We have now done with vertical iron for the present.

A horizontal bar of soft iron at the magnetic poles has no magnetism whatever, since there it is at right angles to the line of force. It is, in fact, in the same harmless position that the

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vertical bar found itself on the magnetic equator. When taken, however, into low latitudes, it gradually becomes magnetic if kept pointing toward the magnetic pole, and has its greatest power in the vicinity of the equator. The red magnetism will always be found in the end which points to the north, no matter which way you may turn it.

As the south magnetic pole is approached, a horizontal bar of soft iron loses force, and at the point of 90° dip, has again ceased to be magnetic. In brief, vertical iron is most magnetic at the poles and horizontal iron held in the direction of the magnetic meridian, is most magnetic on the equator.

Another very marked distinction between vertical and horizontal iron must here be noted. The magnetic intensity of the latter depends not only upon its proximity to the equator, but on the angle it makes with the magnetic meridian. Thus, when held in a north and south direction (magnetic) it is at its best; but on being turned in azimuth it loses power, and when held exactly east and west (magnetic) has none at all. Therefore, unlike vertical iron, horizontal iron on board ship has a varying action upon the compass needle, depending on the direction of the ship's head as well as on the position of its poles in their relation to the compass needle.

This is an important distinction; but there is yet another. Horizontal iron produces the same deviation in all latitudes, for though its power varies with that of the earth, the ratio between the two is constant, and since the first is a disturbing force of the needle, and the other a directing force, it follows that the deviation arising from the induced magnetism of horizontal iron is the same at any part of the globe.

A magnet possesses the peculiar power of producing magnetism in a bar of iron and steel, without loss to itself, and so is capable of propagating its own species to any extent. Therefore, when trying with the kitchen poker, or bar of soft iron, it must not be placed too close to the compass needle, as the latter, if strong, will of itself induce magnetism in the poker when, from the position in which it may be held at the time, none would otherwise exist. Thus, if a common spike nail be held near one pole of a powerful magnet, the latter will first induce magnetism in the nail of a contrary name to itself, and then the law which says that opposite poles attract each other will come into operation, and the nail in obedience will fly to the magnet. The process of making a permanent magnet, which is variously done by "touching" a bar of glass hard steel with the natural loadstone, with another magnet or by electricity, the one under treatment should be surcharged with the magnetic fluid. It never, however, retains all its original strength; but, after a while, settles down into a certain definite state known as "the saturation point," which, if the steel be of the proper temper, it will maintain it for years without appreciable loss, and accordingly gets named a permanent magnet.

A steel ship may be correctly looked upon as in itself a large permanent magnet. She became so in the process of construction; for, although the materials of which she is built are not such as they themselves retain magnetism permanently, it is found that, when united in the form of a ship and subject to percussion by riveting, etc., they acquire this property in a greater or less degree.

After launching and reversal of the ship's head as it was on the building slip, the magnetism undergoes very rapid diminution; but in no case does it depart entirely, and that which is left when the saturation point is reached is accordingly styled sub-permanent. So far there is a great correspondence between the ship, taken as a whole, and the steel magnet. It is evident that the position of the poles of the ship's sub-permanent magnetism must depend first, upon the direction of her head when building; and secondly, upon the "dip" at the part of the world in which she was built. The ship's magnetism, properly speaking, consists of two recognized quantities—sub-permanent and induced magnetism.

TO MARK THE POLES OR ENDS OF A MAGNET.

To tell which end is the north pole and which end is the south pole of a magnet. If you present one end (it makes no difference which end) of a bar magnet to the north point of the compass needle, and attraction takes place, then that end of the magnet must be of an opposite name to that end of the compass needle attracted, or a south or blue pole. If repulsion took place under the same conditions, that is, if the north end of the compass needle was repelled, or driven away from the magnet, the two poles must be like in name, or a north or a red pole. Just try this at the first opportunity. This is the manner in which magnets are marked and painted. Now to prove that you have marked the magnet correctly, just fasten a piece of cord to the magnet's center of gravity, or nearly so, and hang it up on shore in a place free from local attraction, and when it ceases vibrating it will come to rest in a north and south direction. The end you marked north should point in the direction of north and the end marked south, toward the south. Try it. You can likewise prove the principles of the dipping needle in the same manner. To make a dipping needle for experimental purposes: Take a fine piece of steel, say 2½ inches long by ¼ of an inch wide and 1-64 of an inch thick. Have both ends drawn to a point, as nearly equal as possible, then bore a small hole, large enough for a silk thread, through its center of gravity, or as near to it as possible, then hang the needle up by the thread. If you have the exact center of gravity the needle will remain in equilibrium (at a balance) in any position in which it may be placed. If the needle does not balance, file off from the heavy end until it does. After accomplishing this, then have the needle tempered and magnetized. If it then be suspended and be free to assume any direction, it will no longer be indifferent, but will place itself in a particular vertical plane called the magnetic meridian, and will take a particular direction in that plane. Whatever this angle makes with the horizontal plane will be the amount of dip at the place of observation, and a line through the poles at that time is called the line of force at that place. Before suspending the needle by the thread after magnetization, mark its ends according to the foregoing rule. After suspension the north end will be found to dip toward the earth in our latitude.

HOW TO MAKE MAGNETS.

Take a goodly quality of bar steel, say ¾ of an inch wide by 3-16 of an inch thick and eight or 10 in. in length. Have the extremities for about two inches tempered glass hard; and then magnetize it by placing it on top of a dynamo and leaving it there ten or fifteen minutes. Place it so that about half of its length projects over the edge of the dynamo. The stronger the current the stronger the magnet. Magnetizing them with an electrical coil is by far the best, but the above method will answer for all ordinary purposes.

Note.—In painting the ends of a magnet red and blue, leave a little of each end exposed.

To represent the magnetism by coloring, as it really exists, the extreme ends of the magnet should be painted heavy, and then the shade to grow gradually lighter until it becomes nothing at the center, the point of no magnetism.

The reason for leaving the ends of the magnet exposed is for experimental purposes. With the ends painted the magnet would lose none of its magnetic force, but its power of sustaining

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weight (portative force, or power) would be greatly diminished. Magnets used for adjusting purposes are usually sealed in watertight receptacles, made either of brass, copper or wood, through which this force is not impaired in the least. Sometimes these magnets are first painted all over and then a canvas jacket placed over them. This in no way diminishes its magnetic power of force, or its influence on the compass needle, but its power for sustaining weight would be much less than were it left bare.

Magnetic pole.—An end of the axis of the earth's magnetic polarity, not coinciding with a geographical pole, and changing its position slowly. The north magnetic pole is in northern British America at about Lat. 70½°, Long. 97° W.

Marked pole or end, the north seeking end or so-called north pole of a magnet.

Unmarked pole, the south seeking, or so-called south pole of a magnetic needle, or of a magnet.

Polarity.—Polarity is a term that signifies the quality of having opposite poles, as the polarity of the globe, or the property of one end of a magnet being opposite to the property of the other end of it; such as north, or red polarity and south, or blue polarity.

Vessel owners, package freight managers and their employes are alarmed over a vile condition which has arisen in Buffalo river. The water, almost suddenly, grew black and is sending forth a stench which is unbearable. So bad has this condition become that no small number of men employed along the docks in the infected district became ill and were obliged to go home. From the Ohio basin to the docks at the foot of Illinois street the putrid waters menace the marine interests. It is believed to have been caused by sewerage which collects at the bottom of the stream and which by reason of the sluggish condition of the river is not carried down and into the Niagara river. Hot weather has aided in developing the situation into its alarming state. A condition which might have suggested this has been noticed and complained of by vessel men for several years but now that the Hamburg canal and the adjoining slip have been filled the sewerage is crowded out into the river. Gibson L. Douglass, vice president of the Western Transit Co., has made a formal complaint to the health department in which he lays the dangers of the situation before the board and asks for relief.

THE SUBJECT OF COURSES IN NAVIGATION.

The True Course, the Correct Magnetic Course and the Compass Course, as They Are Employed in Navigation.

BY CLARENCE E. LONG.

Here is a difficult subject to understand, not only by the beginner, but by many of those well versed in the mysteries of navigation. This subject is not a hard one to master by any means when it is explained as it should be. Where the trouble lies is in so many books calling them by names other than what they really are, and thereby giving them wrong definitions.

There are three principal kinds of courses. To conduct a vessel from one place to another when out of sight of land involves a knowledge of the true course, the correct magnetic course and the compass courses, and their conversion from one into another.

To start with we must first determine how each such course derives its name and the basis for computation. The first thing then, to be taken into consideration is the initial line that each is measured from. These initial lines are the true meridian, the magnetic meridian and the meridian of the compass. The latter is a line passing through north and south on the compass card.

All directions in the first place are measured from the "true" meridian since the "true" meridian is the starting point for direction. "True" meridians, also known as geographical meridians, are lines conceived to be drawn on the earth's surface from one "true" pole to the other. Their direction is exactly "true" north and south.

As the "true" poles of the earth are fixed points, and have always the same "true" relative bearing, and all "true" meridians are parallel to one another, the "true" meridian, therefore, readily affords the standard by which all terrestrial directions are determined.

"True" meridians are really imaginary great circles on the surface of the earth passing through the "true" poles or ends of the earth's axis. As the curvature of the earth is not considered for small areas neither is the curvature of the meridian considered for those areas, and this accounts for them being straight lines on some charts, and very nearly so on others; the chart projection, of course, having something to do with it, too. Meridians may also be defined as true north and south lines running from the top to the bottom of the chart, or in the direction of the "true" poles of the earth. They are called meridians because they mark all places which have noon at the same instant, and also, they mark out all places which have the same longitude, and this is why they are called meridians of longitude. The "true" meridian of a place on the surface of the earth is a great circle passing through the place and the poles of the earth.

But why do we employ the qualifying term "true" meridian and "true" pole. The dictionary does not define "true" meridian, but says a meridian is an imaginary great circle on the earth's surface passing through the poles.

In navigation it is really necessary that the word "true" be prefixed to meridian in order to distinguish it from "magnetic" meridian, and also "true" pole to distinguish it from "magnetic" pole.

The magnetic meridian is a magnetic north-and-south line, or it is the natural direction pointed out by a freely swinging magnetic needle when not disturbed by any magnetic force other than that of the earth's magnetism. The magnetic meridian of any place is the direction which a freely swinging magnet takes at any place when at rest, and is acted upon solely by terrestrial magnetism which gives every such needle the power of direction by its own attraction. Or, the magnetic meridian of a place is the vertical plane passing at the place through the two poles of a movable magnetic needle at rest about a vertical axis.

Magnetic meridians are very irregularly curved lines as they wind round the earth and pass from one magnetic pole to the other. They are unlike the true meridians in that they lack symmetry and are non-parallel to each other. The compass needle (which carries the compass card) is essentially a freely swinging magnet, and when it is unaffected by any local disturbing force, but is controlled wholly by the earth's magnetism, it points directly to the north magnetic pole of the earth. But the magnetic pole toward which the compass points does not coincide with the end of the earth's axis or true pole, hence the compass needle does not everywhere indicate a true north-and-south line. Since the magnetic pole is some distance from the true or fixed pole, the needle in pointing to the magnetic pole, must for the most part, make an angle with the true meridian. The angle which the needle makes with this true meridian is called the variation of the compass.

The earth itself is a huge magnet; with two poles; its magnetic north pole is located beneath the northern part of North America, and the other beneath the antarctic regions; both these poles very gradually change their position, though they seem to be confined to the arctic and antarctic regions respectively. The lines of magnetic force (the earth's magnetism in general and which causes the needle to point) of this great terres-

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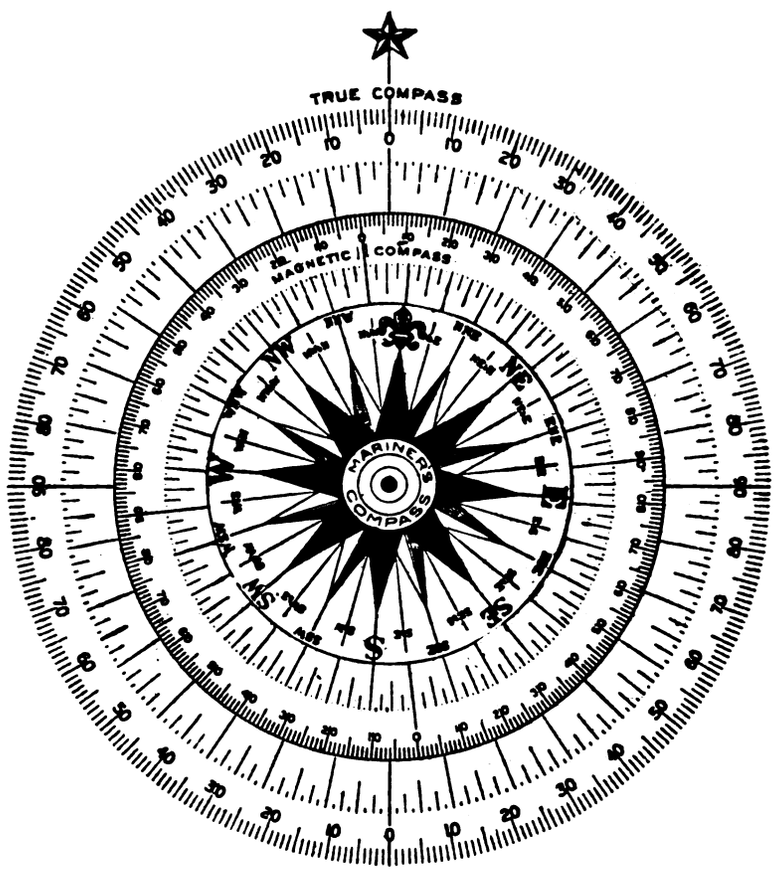
trial magnet are usually called magnetic meridians, or the lines of equal variation shown on a magnetic chart, also technically known as isogonic lines.

To make this clearer, imagine the earth to be covered with freely swinging magnetic needles without influence upon one another. We would find them pointing very different at different places, but, notwithstanding this, they would all be pointing toward the same magnetic pole. They point different because the magnetic pole is to one side of the true pole, from which direction is reckoned. The true pole is at the end of the earth's axis and has always the same direction from all points on the earth's surface, while the magnetic pole on the other hand, changes its line of bearing as one changes his position. The greater the angle between the direction as pointed out by the magnetic needle at any place and the true meridian of the same place, the greater the variation, and the less the angle the less the variation.

We would find certain of these magnetic needles having no angle at all with the true meridian, and here there would be no variation; a line joining all such needles is called the "line of no variation." In other words, the compass and chart agree on this line, or the compass points true since the true and magnetic poles are in line with each other.

We would also find certain of these magnetic needles having the same angle with the true meridian. If we were to follow a line of needles which have all, say five degrees westerly variation, we would pursue a magnetic meridian (or line of force) that would have the same angle throughout with the true meridian. If we joined all such needles by a line we would trace on the globe a very irregular line. Such a line would also be called an equal line of variation. We would also find certain of these needles pointing to the right of the true meridian and this would be called easterly variation, and certain of them would point to the left of the true meridian, and this would be called westerly variation.



If we traced through the line of needles having all the same angle with the true meridian, and took each in turn, we would have traced many devious curves before reaching the magnetic pole. The lines for each angle would resemble a mass of tangled wires but without touching or crossing one another. Each of these magnetic meridians indicates the direction in which a freely swinging magnet will settle to rest on that meridian.

"Magnetic course" is the natural direction shown by the compass that is under the influence of terrestrial magnetism only; or in other words, a compass without deviation. Such an ideal condition could only be found in a compass placed in a wooden vessel without a particle of iron used in her construction, equipment, etc. Now, if you were to steer any course by such a compass you would be making truly a magnetic course, but a devious one on the earth's surface. Say the course is NE, then to trace the ship's track on a chart, its direction would depend entirely on the angle the magnetic needle made with the true meridian at various places along the track. If a considerable distance had been covered the course might be a very devious one. It must be plain to be seen that a "magnetic" course is of no account in navigation, since it cannot be used. It would be impossible to arrive at a certain point by following the compass when affected by various amounts of variation, as it must be in covering a considerable distance. If the variation were of the same amount all along the course it would help matters to some extent. But, as charts are laid down according to true meridians and never according to magnetic meridians all directions must first be referred to the true meridian.

A "correct magnetic course" is either a true course corrected for variation or a "compass" course corrected for deviation, or it is simply the angle which its direction makes with the magnetic meridian. "Correct" magnetic is, by many writers, too often misapplied by being called simply "magnetic." It will be readily seen from this that there is a wide difference in the two meanings, and therefore, it is very incorrect to use "magnetic" for "correct magnetic." Any kind of course steered by a compass is "magnetic" in a certain sense, but it does not signify that the course has been corrected for either variation or deviation. Magnetic course implies the natural direction of the compass needle, or the directions shown by the card carried by the needles.

"Correct magnetic" does not mean correct in its literal sense, but is used figuratively. It does not mean that the "magnetic" course was incorrect and that by correcting it is made "correct." It means that either the true course or the compass course has been corrected for variation or deviation, and that the result is the "correct" magnetic course. It is thus qualified to distinguish it from the "compass" course and the "true" course, or from the "magnetic" course, but since magnetic course has no significance in navigation when its real meaning is taken into account it is unnecessary to distinguish between them. It is not necessary to use "magnetic" course at all.

If you will look at the accompanying picture of a chart compass, called com-

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pass "rose," showing one point of easterly variation, you will have no trouble in distinguishing between "magnetic" and "correct" magnetic. If you were to steer north by "magnetic" compass (the inside compass) you would in reality be steering N by E true (by outside compass). If NE by magnetic compass it would be NE by E by true compass. Thus, with easterly variation the true points corresponding to the magnetic points are to the right of the magnetic points by the amount of the variation. With westerly variation the true points corresponding to the magnetic points are to the left by the amount of the variation.

Now, if we desired to steer true north by this compass affected with one point of easterly variation we would first allow the amount of the variation to the true course in the opposite direction that the needle is deflected from the true meridian, the result is the "correct" magnetic course, the true course corrected for variation.

You will notice from this compass rose that with easterly variation the true directions corresponding to the correct magnetic directions are to the left of the magnetic meridian; therefore, in allowing for easterly variation in correcting a true course to get a correct magnetic course, we allow it to the left of the true course.

A "magnetic" course or bearing as given in "sailing directions" and on charts is the correct magnetic course and bearing and not the magnetic course and bearing; since they are the true courses corrected for variation.

Now, bear this in mind: The amount that the "magnetic" needle in its natural state is turned aside from the true meridian is the variation of the compass, the true meridian being the line from which it is measured; and where the true points of the horizon intersect with the magnetic points of the horizon as read from the magnetic compass are the correct magnetic points corresponding therewith, or what is the same thing, the true points corrected for variation.

"Compass" course is another term very often misapplied. The compass course is the course to be steered after the variation and deviation have been applied to the true course, or when the deviation has been applied to the correct magnetic course; the result in either case is the compass course. Or, the compass course is the angle which the track of the ship makes with the north and south line of the compass card; such a course is affected with deviation and variation; applying the deviation to the compass course the result is the correct magnetic course; applying both the deviation and the variation to the compass course the result is the true course.

A steam vessel and a sail vessel with a fair wind can steer the true course to be made good by compass from the start by applying the variation for the locality to the true course which gives the correct magnetic course, and then the deviation for the ship's head corresponding to this correct magnetic direction, applied to this correct magnetic course gives the compass course; and although the course by compass may differ considerably from the true course it is in reality the true course started with.

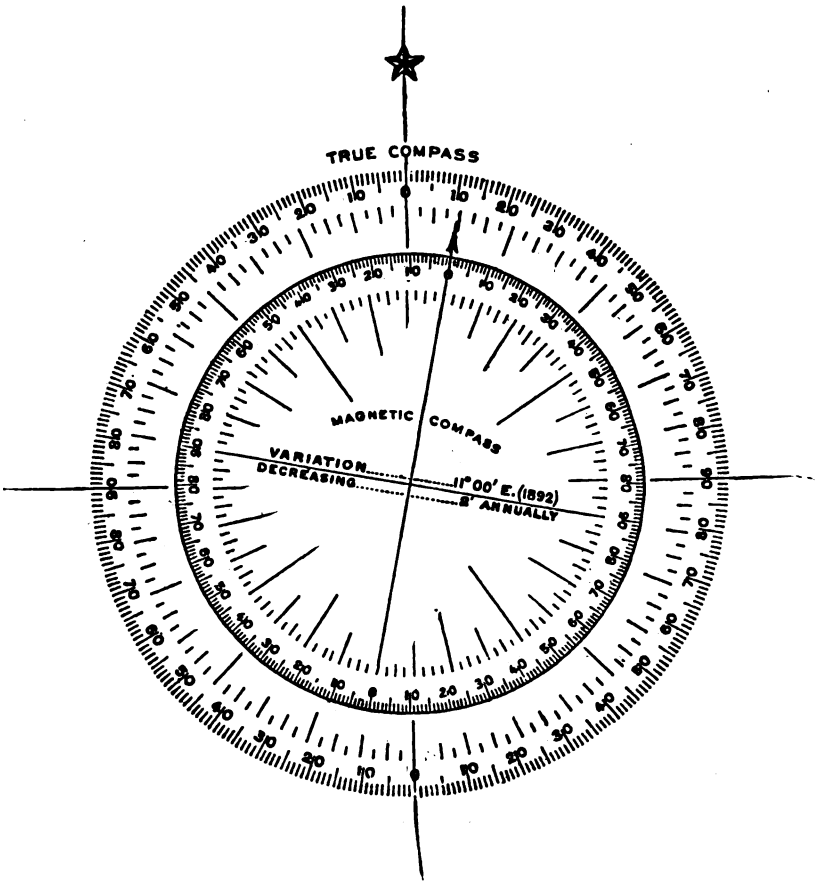
A sail vessel beating to windward cannot do this, since the direction of her head is governed by the direction of the wind. She is put as close to the wind as she will sail, and the course by compass is noted. It is the compass course since it is the angle the ship's track makes with the north and south line of the compass card, or it is the compass course, because as a usual thing, the course is affected by both deviation and variation. To get the true direction she has sailed in from the compass course steered so as to make it conform to the true direction of the chart, this compass course must be converted into a true course by applying both the deviation and variation by the amount that the compass course is affected; viz.: easterly deviation and variation to the right of the compass course and westerly deviation and variation to the left of the compass course.

The same thing is true in taking the compass bearing of a lighthouse or other object on shore, and laying it down so that it will conform with the same object on the chart. To make it correspond with the true directions of the chart the compass bearing must be converted into its equivalent true bearing. This is called converting a compass bearing into a true bearing. The process is just the reverse of converting a true course or bearing into a compass course or bearing.

The difference between a true course and a correct magnetic course is the variation, therefore, if we apply the variation to the true course the result is the correct magnetic course; and, similarly, if we apply the variation to a correct magnetic course the result is the true course. It is plain to be seen that the two rules are the reverse of each other.

If there is no variation the true course is also the correct magnetic course, and vice versa, the correct magnetic course can also be the true course when there is no variation.

The difference between a correct magnetic course and a compass course is the deviation, therefore, if we apply the deviation to the correct magnetic course



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the result is the compass course, and, similarly if we apply the deviation to a compass course the result is the correct magnetic course. The two rules of application, are of course, the reverse of each other.

If there is no deviation the correct magnetic course is also the compass course, and vice versa, the compass course can also be the correct magnetic course.

If there is neither variation nor deviation the true course is likewise the compass course, and vice versa.

A few examples will explain the rules of applying variation and deviation from true course to compass course, and compass course to true course:

The true course is N 50° E, variation 6° westerly, deviation 12° easterly, what is the compass course?

True course ..... N 50° E
Variation Wly. (add) 6° (allow to the right.)
Correct magnetic course..... N 56° E
Deviation Ely. (sub.) 12° (allow to the left.)

Compass course .. N 44° E

From compass course to true course:

The compass course is N 44° E, deviation 12° easterly, variation 6° westerly, what is the true course corresponding to the above compass course?

Compass course.. N 44° E
Deviation Ely. (add) 12° (allow to the right.)
Correct magnetic course ..... N 56° E
Variation Wly. (sub.) 6° (allow to the left.)

True course .....N 50° E

Supposing that you were steering N 44° E with the above variation and deviation and you took the bearing of a lighthouse by compass, and say it was S 12° E, what would be its corresponding true bearing?

Compass bearing.. S 12° E
Deviation Ely. (sub.) 12° (allow to the right.)
Correct Magnetic bearing .....S 0 E = South.
Variation Wly. (add) 6° (allow to the left.)

True bearing .....S 6° E = S ½ E.

Note.—In bearings of this kind always remember that the deviation to be applied is due to the direction of the ship's head at the time the bearing was observed, *and not the deviation for the point of bearing.*

When the variation and deviation are of the same amount, but unlike in name (one counteracting the other) the true course is likewise the compass course. For example:

The true course is NE, variation ½ point easterly, deviation ½ point westerly, what is the compass course? Answer NE, the same as the true course started with.

Variation is measured from the true meridian to the magnetic meridian. When the variation is applied to the true course the result is the correct magnetic course, hence their difference is the variation.

Deviation is measured from the magnetic meridian to the line passing through the north and south points of the compass card. When the deviation is applied to the correct magnetic course the result is the compass course, hence, their difference is the deviation.

Variation is the same for all directions of the ship's head in the same locality. This is because the variation is due to the earth's magnetism which controls the needle, and since the compass needle points to the north magnetic pole, and this pole has practically the same relative bearing for any one position on the earth, it makes no difference which course we may desire to steer on from this one position the variation must remain the same. Therefore, the variation is outside of the ship's hull and is independent of the deflection of the compass needle known as deviation.

Deviation of the compass is the angle through which north and south on the compass card is deflected from its natural magnetic position by the disturbing force of iron near it. Every ship is a magnet having magnetic poles of precisely the same character (only greater) as the compass needle, and also of the same character as the magnetic poles of the earth's magnetism, that is a north magnetic pole and a south magnetic pole. The ship's magnetic poles are located somewhere within the hull, depending on the magnetic latitude in which she was built, and the direction of her head while building.

Deviation is due entirely to the magnetism of the ship itself, and is therefore independent of all influences outside of the ship such as the variation and local attraction.

The deviation unlike the variation, is of a different amount on nearly all courses of the compass and is of an opposite name in reverse semi-circles of the compass, that is to say, if the natural total deviation on NE is easterly the natural total deviation on S W would be westerly; one end of the compass needle being attracted in the one case and the opposite end in the other case. The reason that the deviation is of a different amount on different courses is due to the fact that the ship's magnetism (the magnetic poles) changes its line of direction with respect to the compass needle (which is supposed to remain stationary pointing always to the north magnetic pole of the earth) at every change of the ship's head. When the magnetic poles of the ship's magnetism are in the same line with the compass needle's length the deviation will be least since the magnetism is pulling in the same direction as the needle is pointing, the tendency being to hold it in its natural position. But when the ship is heading in such a direction that the poles of her magnetism are at right angles to the needle's length, the deviation, or deflection will be greatest.

The corrections of the compass (not compass errors) are those quantities which must be applied to the indications of that instrument to obtain the reading that would be given it if the north point of the compass card always corresponded to the true north point of the horizon. These quantities are the variation and deviation. They are corrections and not errors of the compass, since they are not faults of the compass but are due to well defined laws of nature. They are just what any good navigator would expect his compass to indicate when brought under the influences that cause them.

The idea is to find the course to be steered by compass in order to make good the true course, which is the angle the real track of the ship makes with the true meridian. We know that the compass does not indicate true directions, but on the contrary is deflected from this meridian by the influences known as variation and deviation. Therefore, when the corrections for these quantities are known and applied to the compass we get the direction that would correspond to the true direction were the compass always to point true instead of otherwise. The same thing is true when we apply these quantities to what we know the true directions to be in the first place, and while these directions according to the compass will be of a different name than the true course started with, it is nothing more than the true course, because in order to find out where the ship is, when out of sight of land, her real course must be measured from the true meridian.

The "true" meridian is in the direction that the imaginary needle of the true compass points.

We learn that all magnetic bodies have north and south magnetic poles and that unlike magnetic poles attract each other and like poles repel each other. This being the case the compass needle being a magnet it must have a north and south magnetic pole and so it has, likewise the earth which is a huge magnet has a north and south magnetic pole. The magnetic poles of the earth are what cause the compass needle to point to them, and the ship's magnetic poles are what cause the compass needle to point to them and away from the magnetic poles of the earth. The deflection of the compass needle caused by the ship's magnetic poles is called deviation and the deviation is measured from the magnetic meridian.

To Determine the Deviation when on with a Range.—To the true bearing of the range apply the local variation, so as to make a correct magnetic bearing of it. The difference then between what

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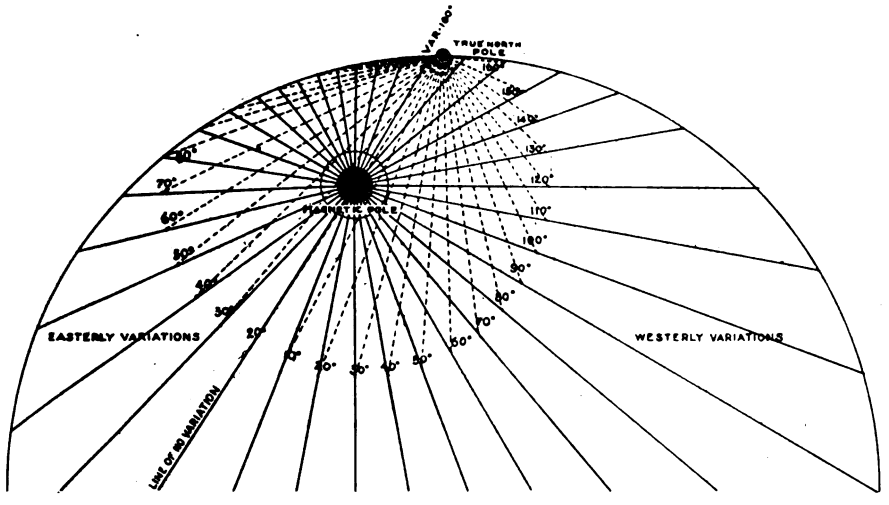
of it. The difference then between what you know this correct magnetic bearing to be and what the compass reads when in line with the range is the deviation for that correct magnetic course. If the correct magnetic bearing is to the right of the compass bearing the deviation is easterly by the amount of the difference between the correct magnetic bearing and compass bearing. If the correct magnetic bearing is to the left of the compass bearing the deviation is westerly by the amount of the difference between the two bearings.



The above diagram shows the position of the north magnetic and true poles and the manner in which the compass needle points to the magnetic pole at all places on the earth's surface. Why the variation is named easterly and westerly, and why at some places there is no variation. The plain lines in the illustration are the magnetic meridians or equal lines of variation. On the earth these lines are not straight as shown above, but are very irregular curved lines as already mentioned. The dotted lines from the center of the compass needle to the true pole are the true meridians. Variation is measured by the angle between the true and magnetic meridians. The illustration also shows why it would be necessary to steer south by compass to go direct from the magnetic pole to the true pole. A careful inspection of this diagram ought to make all these matters very plain.

An example will better illustrate this. True bearing of range is NE, variation 6° westerly. While on with this range the compass reads NE ½ N. How much and which way is the deviation? 6° equals ½ point, and being westerly we allow it to right of the true bearing to get correct magnetic bearing. Therefore, ½ point to the right of NE is NE ½ E, the correct magnetic bearing. Difference between this and compass bearing NE ½ N is one point of deviation, and is named easterly since the correct magnetic bearing is to the right that much of the compass bearing, or the whole card is swung to the right by one point of easterly deviation.

The above diagram illustrates graphically the above example. To get compass course from true course move from true compass in on the compass card representing the compass on board. To determine the true course steered from the compass course steered, move from the inside compass to the outside compass.

Shore Engineer Greiner, of the Pittsburg Steamship Co.'s fleet, left Ashtabula on the steamer Manola last week. He did this to look over her engines.

QUESTIONS FOR OILERS AND WATERTENDERS.—NO. 2.

In the list of questions for oilers and watertenders last week an amusing error was made in reproducing question 10. The question as written by the instructor was: "Why is the L. P. cylinder of a compound engine larger than the H. P.?" As it appeared in the paper it read: "Why is the L. P. cylinder of a compound engine larger than the horsepower?" The abbreviation H. P., of course, stands both for "high pressure" and for "horsepower." All newspapers must have a fixed style of composition. The MARINE REVIEW style is to spell out "horsepower" whenever the abbreviation is not used in conjunction with the numeral, denoting the degree of horsepower. As all H. P.'s look alike to the intelligent proofreader, this was seized upon and put into strange service. Following is the second list of questions for oilers and watertenders:

11. Why do high-speed engines have a short stroke compared with the diameter?
12. Name a disadvantage.
13. Name an advantage.
14. What is an overhanging crank?
15. What is meant by the terms "lead" and "throw" of an eccentric?
16. Have we any engines where the eccentric follows the crank, if so, name the kind of valve used?
17. What would cause a fusible plug to blow, if water level was at its proper height?
18. Name three important duties in the care of a tubular boiler.
19. Would you close the steam valve to a high-speed engine if you thought water was coming back through the exhaust line?
20. What would you do if the water in the boiler raised high enough to flow over into the auxiliary machinery?

QUESTIONS FOR WHEELSMEN AND WATCHMEN.—NO. 6.

Give all shoals and landmarks passed on either hand.

62. What is the true range of Ashtabula harbor?
63. What is the correct magnetic range of Fairport harbor?
64. How would you enter Cleveland harbor?
65. What dangers are to be avoided entering Cleveland harbor main entrance?
66. Going through south passage coming from eastward with South Bass island in view and Green island shut into the northward of South Bass island, what would you do?
67. How does Waverly shoal bear from Buffalo breakwater light north entrance?
68. How does Seneca shoal gas buoy bear from light on south entrance Buffalo breakwater?
69. How does South Bass island light bear from Kelleys island south shoal gas buoy?
70. How does Starve island reef gas buoy bear from Green island lighthouse?
71. How does Mouse island can buoy bear from South Bass island light?

QUESTIONS FOR MASTERS AND MATES.—NO. 5.

The MARINE REVIEW begs to announce to masters and mates in connection with the question course now running in the paper that it is not essential that the questions should be answered weekly. It is natural that there should be among the questions a number that cannot be readily answered. If they could it would be useless to project the course. The contest will continue for about a year and masters and mates may, if they wish, defer their answers until the end of the season of navigation, when they will have more time to devote attention to the subject. Of course, there is no objection to the answers coming in weekly—the point is that it is not essential that they should come in weekly. It is gratifying to the MARINE REVIEW to announce that an increasing interest is being taken in the course. No person can pursue it without profit. Following is the fifth list of questions:

70. Where is the equator of a magnet?
71. Where is the greatest amount of magnetism of a magnet? Where is the least amount?
72. Is there as much magnetism in one end of a magnet as there is in the other end of the same magnet?

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73. What is meant by blue polarity and red polarity?

74. What is the difference between red polarity and south magnetism?

75. What is the difference between south magnetism and blue polarity?

76. What is the neutral line of all magnetic bodies?

77. Why is it that iron filings cling to the ends of a magnet and not to its middle portion?

78. What are the lines of force of any magnet?

79. What is meant by the magnetic field of a magnet

80. What magnetic lines conceived to be drawn on the earth represent the magnetic field of the earth's magnetism?

81. What is a magnetic needle?

82. What is meant by magnetic dip? Where is it greatest and where is it least?

83. Why do iron filings cling to both ends of a magnet alike?

84. What would be the result were you to present the north pole of a bar magnet to the north pole of a movable magnetic needle?

85. What is a natural magnet?

"ALONG THE SAGUENAY."

To say that the inhabitants of Chicoutimi and the Saguenay provinces are fifty years behind the times would be to do them an injustice. The strife and turmoil of the outer world never penetrates this region; the noise and confusion, the insolent discourtesy so frequently encountered, the nervous, restless, ever-surging throng of the metropolis live not even in the minds of these simple people. The rugged heights that hem them in, the broad waters of the St. Lawrence, the sombre tide of the Saguenay, mark the boundaries of their little world. To them the rest of the universe is a sealed book, save from the tales handed down from generation to generation of the old home in sunny France, whence came the sturdy pioneers whose descendants now occupy the very land they struggled long and manfully to acquire and who in turn will hand it down to posterity. Unfortunate they may seem at first thought, yet the more one studies their characteristics, the closer he investigates their condition, the greater is the inclination to pity himself. Gentle, quiet, happy to a degree that is infectious, there is an air of contentment everywhere in evidence that is in strange contrast to the strife and discord that prevail in the outer world, the keen competition, the glittering possibilities, the bitter disappointment attendant on failure, are all foreign to them, and their cup of joy appears ever ready to bubble over.

Happy people indeed are they, benighted they may be, yet it is with a feeling akin to regret that the stranger within their gates turns his back on the peace and quietude that abound everywhere here, to begin the homeward journey toward the strife, turmoil and selfishness of the outer world. Lucky people they, fortunate is the man who is permitted to spend even a few days amid such mellowing influences.

LAUNCHING THE JOSHUA RHOADES.

The steamer, Joshua Rhoades, building for W. H. Becker, of Cleveland, was launched at the Lorain yard of the American Ship Building Co. at noon Saturday last and was named by Miss Helen Bartow. The Rhoades is 440 ft. over all, 420 ft. keel, 52 ft. beam, and 28 ft. deep. Her engines are triple-expansion, with cylinders 22, 35 and 50 in. diameter by 40-in. stroke, supplied with steam by two Scotch boilers 13½ ft. in diameter and 11½ ft. long, fitted with Ellis & Eaves draft and allowed 180 pounds pressure. The launching party was unusually large and was entertained at the Clifton club at the conclusion of the launching by Mr. J. C. Wallace, president of the American Ship Building Co.

LAUNCHING THE STEAMER JOSHUA RHOADES.

ORDERS ANOTHER STEAMER.

Messrs. Wm. A. and Arthur H. Hawgood closed contract with the American Ship Building Co. last week for a 10,000-ton freighter. This is the second order that the Hawgoods have given to the American Ship Building Co. for a bulk freighter for 1907 delivery. The new steamer will be 552 ft. over all, 532 ft. keel, 56 ft. beam, and 31 ft. deep. She will have thirty-two hatches spaced 12 ft. centers. Her engines will be triple-expansion, with cylinders 23½, 38 and 63-in. cylinder diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 14 ft. six inches by 11 ft. six inches, equipped with Ellis & Eaves draft, and allowed 180 lbs. pressure. This makes thirty-one bulk freighters under order in various ship yards of the great lakes for next year's delivery. Twenty-two of these vessels will be built by the American Ship Building Co., seven by the Great Lakes Engineering Works, and three by the Toledo Ship Building Co. A few of these will probably be completed late in the fall of 1906, but not in time to have any sensible influence upon the lake trade of the present season.

The Cunard line has recently received a deputation from the Hungarian government, offering terms to the company for the acquisition of the immigrant trade between Freune and New York. The proposals involved the purchase of the Cunard steamships Slavonia, Ultonia and Carpathia, and the payment of an indemnity for the annulment of the contract between the Cunard line and the Hungarian government, which has still some years to run. The directors of the Cunard line are considering the matter.

James Kitchen, of Kirtland, O., who was wheeling on the steamer Zenith City last season, is now second mate of the same ship.

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THE MARINE REVIEW

VOL. XXXIV. CLEVELAND, AUGUST 16, 1906. NO. 7.

FRONT VIEW

"CYCLONE"

HIGH-SPEED CHAIN HOIST

With Self-Lubricating Bearings

High Efficiency High Speed Great Durability

ALL GEARS CUT

THE lift wheel, Fig. 1, that is the sprocket wheel which carries the lift chain, is cast in one piece with the spur wheel that drives it. This double wheel turns freely upon a hollow shaft rigidly supported at both ends in the frame. The spur wheel is encircled by a yoke having internal teeth meshing into the spur wheel teeth and driven with a gyrating movement into the spur wheel placed diametrically opposite. See Fig. 2. The hand wheel shaft, passes through the hollow main shaft carrying at the further end a pinion which drives two spur wheels, one on each of the two eccentric shafts. See Fig. 3.

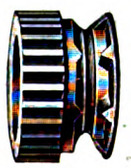
Fig. 1.

The number of the teeth in the spur wheel divided by the difference between the number of the spur wheel teeth and the number of the internal teeth of the yoke equals the number of revolutions of the eccentric necessary to turn the lift wheel once. (In the one-ton size, the spur wheel has twenty-one teeth, the yoke twenty-four internal teeth, and the eccentrics turn seven times to each revolution of the lift wheel.) The teeth are cut with accuracy and work smoothly together. There are a number of them in contact, insuring great strength. The eccentric shafts have bearings at both ends and roller bushed connection with the yoke. All bearings have self-lubricating GRAPHITE BRONZE BUSHINGS. There are no overhanging bearings in the Hoist, so that under the full load the frame will not spring and bind the working parts. The extreme simplicity and great strength of this construction is apparent. It is as practicable for the twenty-ton size as for the half-ton without undue increase in size or weight.

The friction loss of this movement is so slight (THE EFFICIENCY IS ABOUT EIGHTY PER CENT,) that it has been found practicable to gear the Hoists to a very high speed, higher than that of any other Hoists yet manufactured, without increasing the hand wheel pull above that of other slower Hoists.

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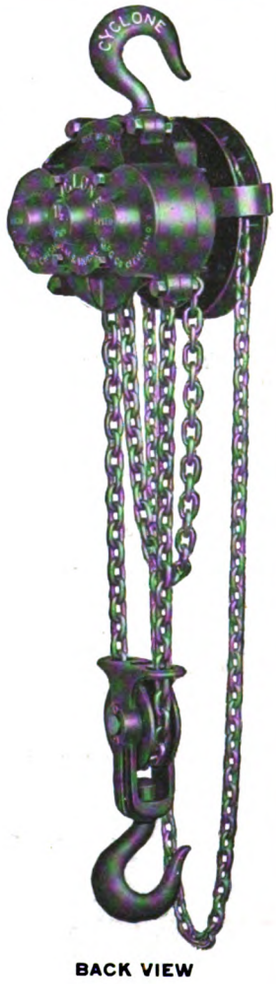

BACK VIEW

FIG. 2

FIG. 3

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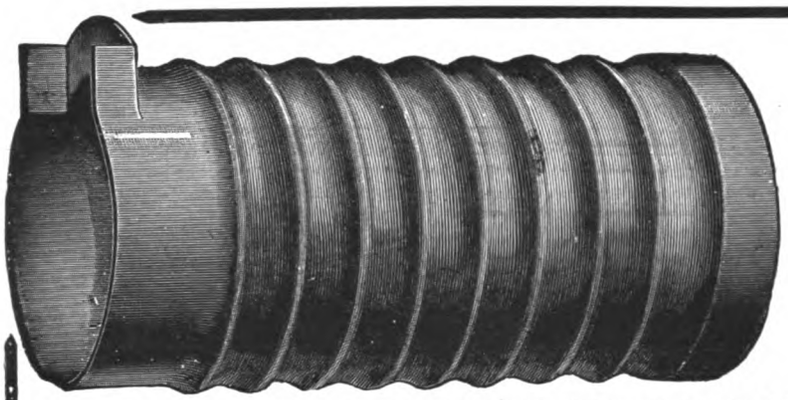

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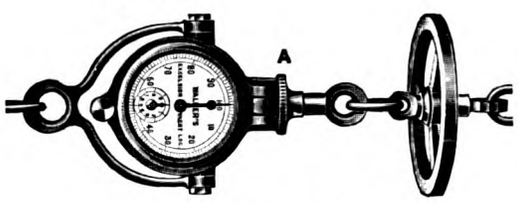

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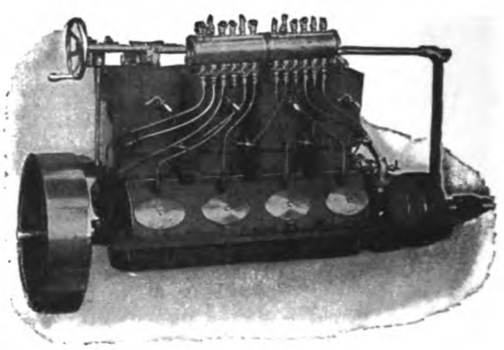

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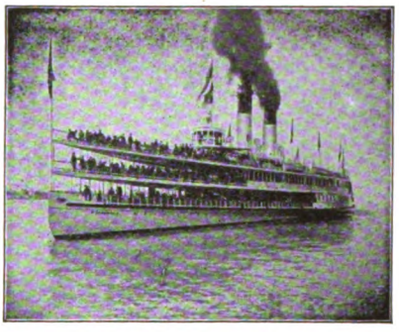

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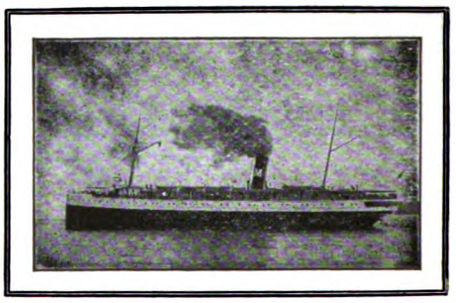

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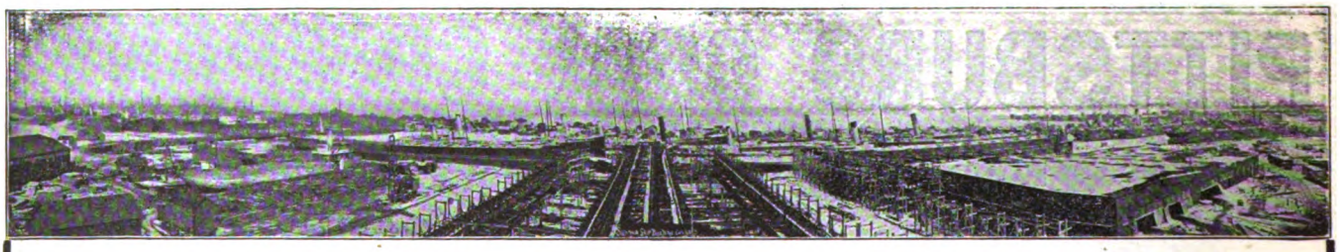

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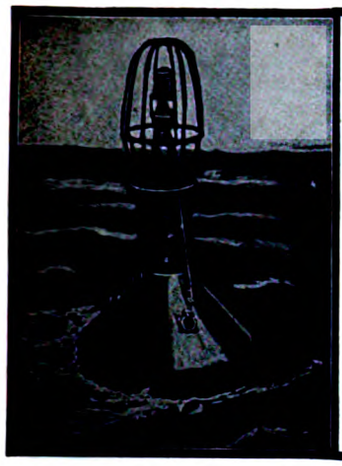

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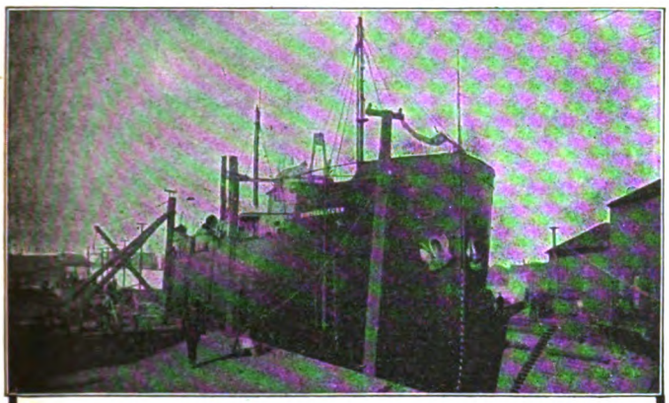

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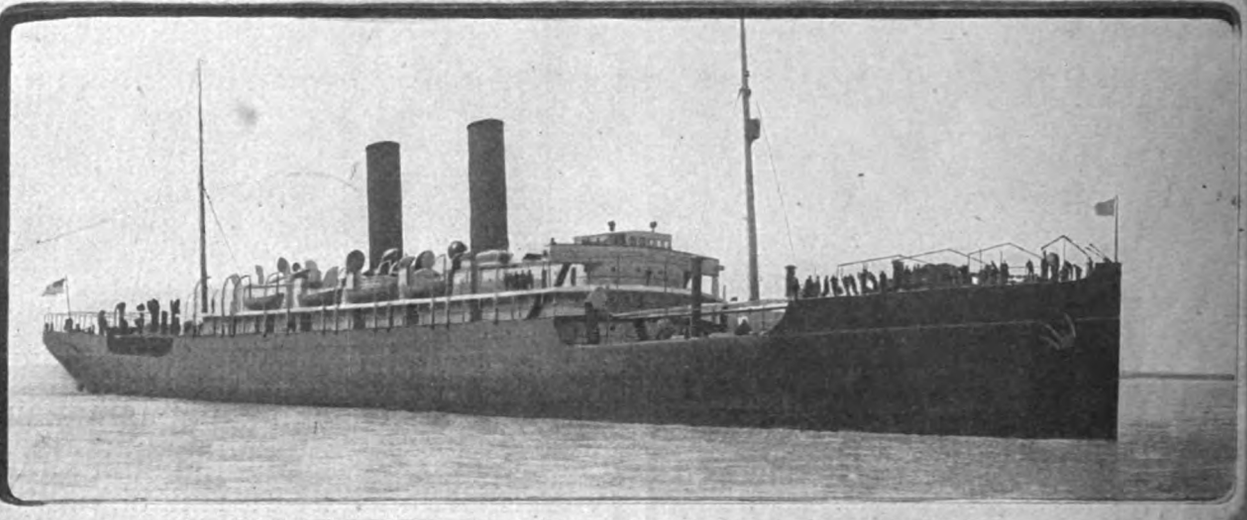

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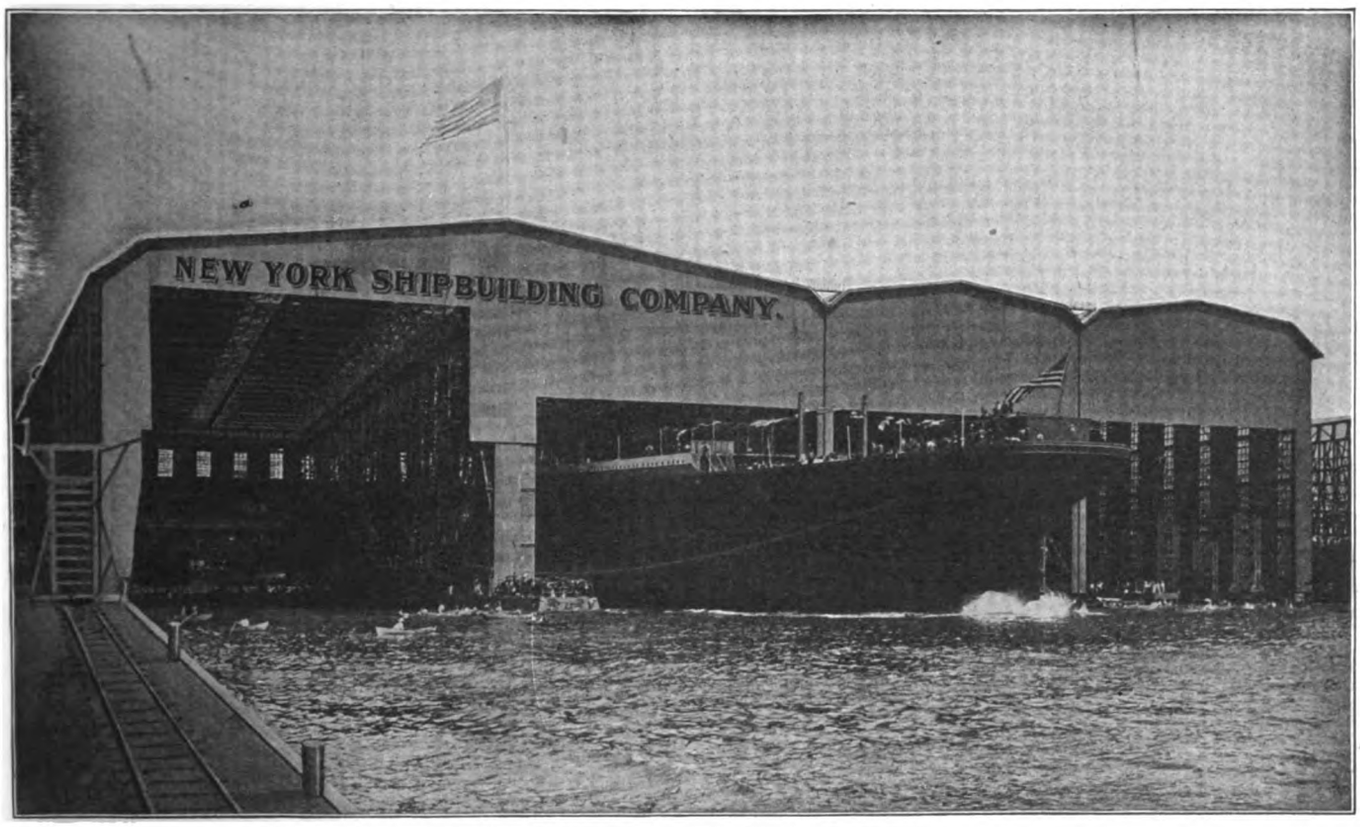

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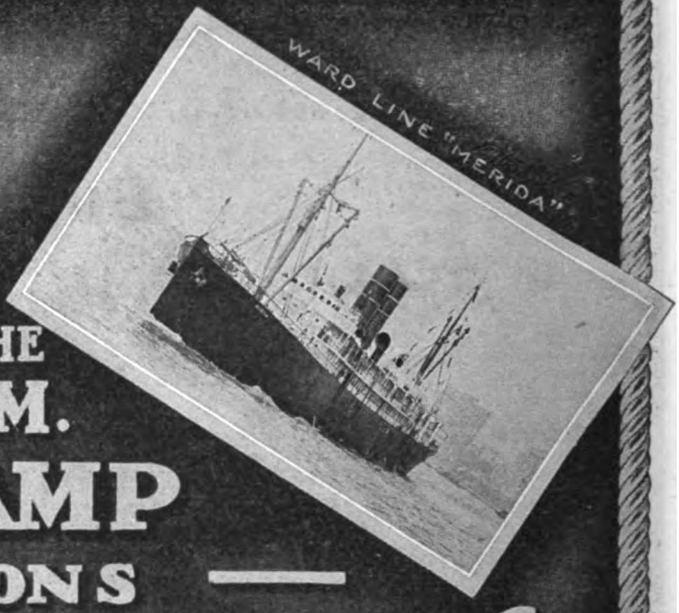

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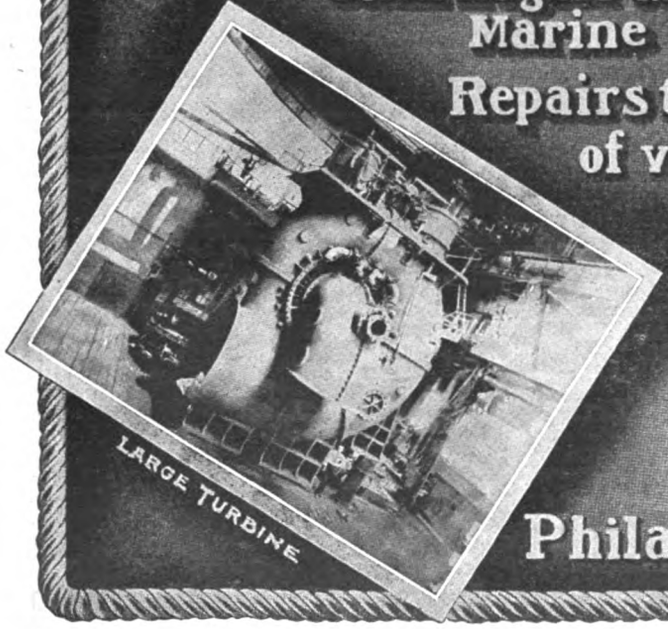

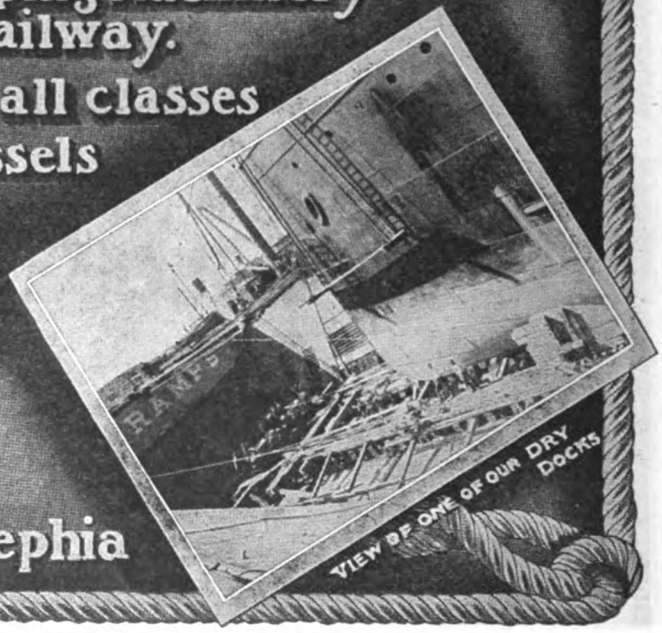

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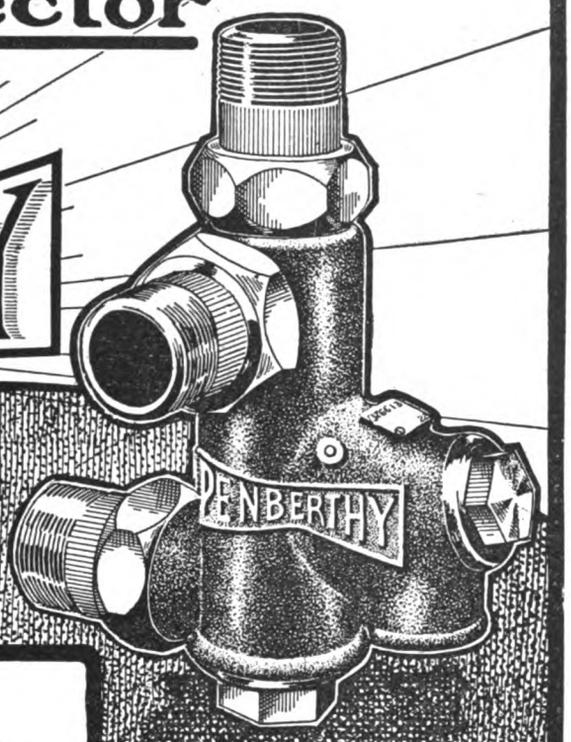

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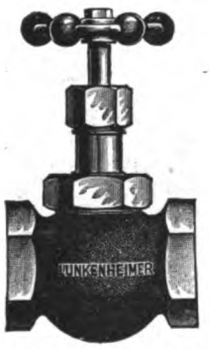

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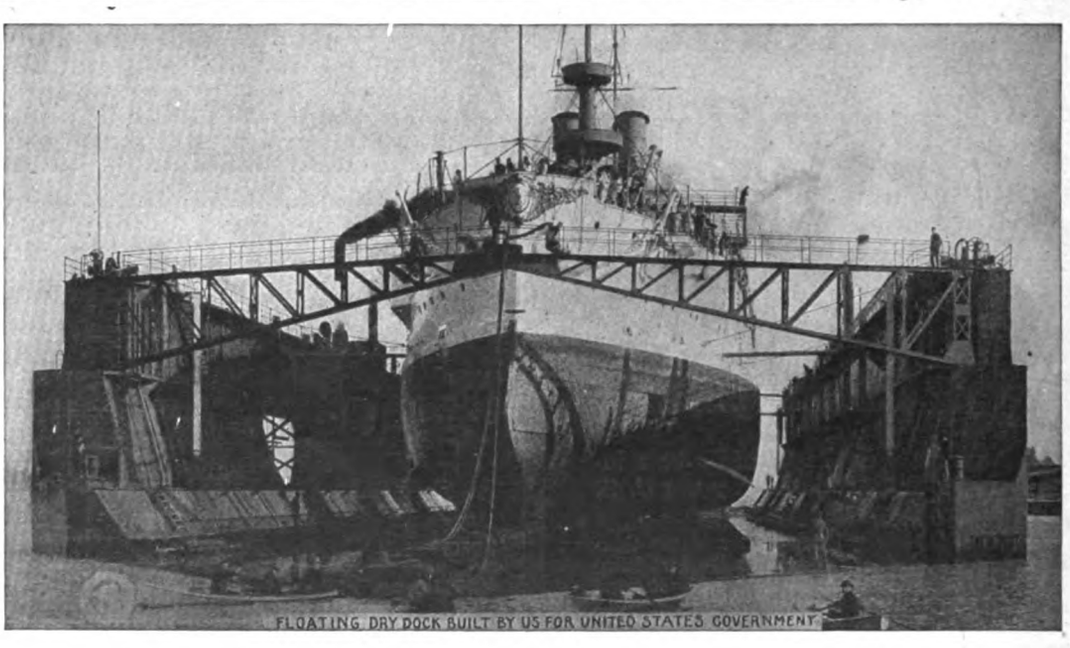

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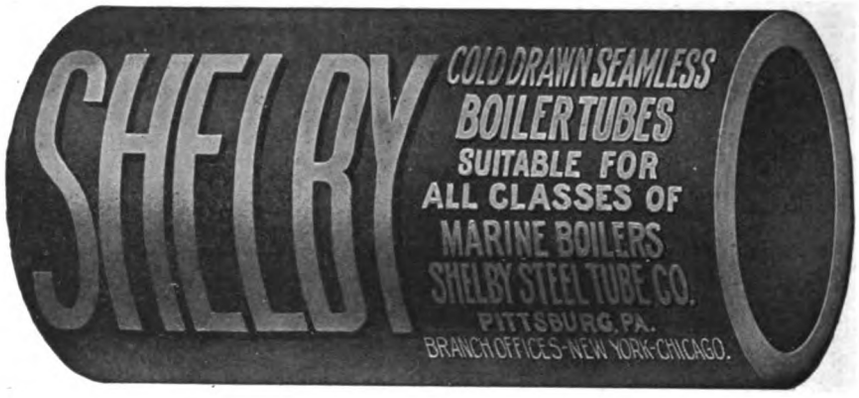

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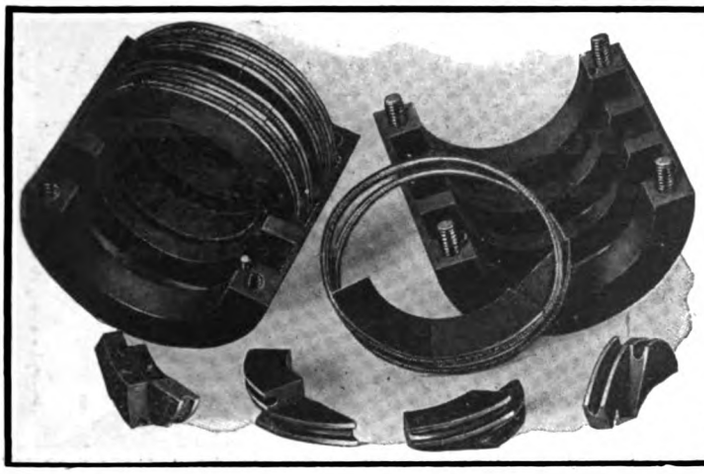

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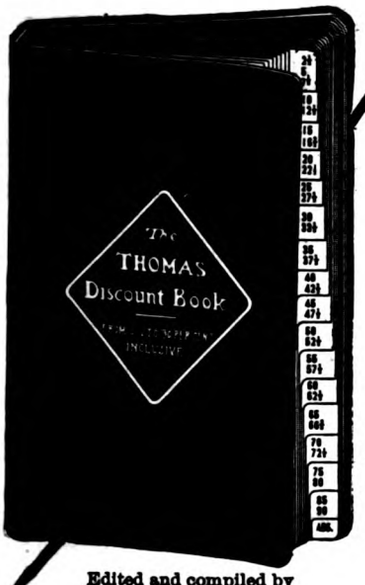

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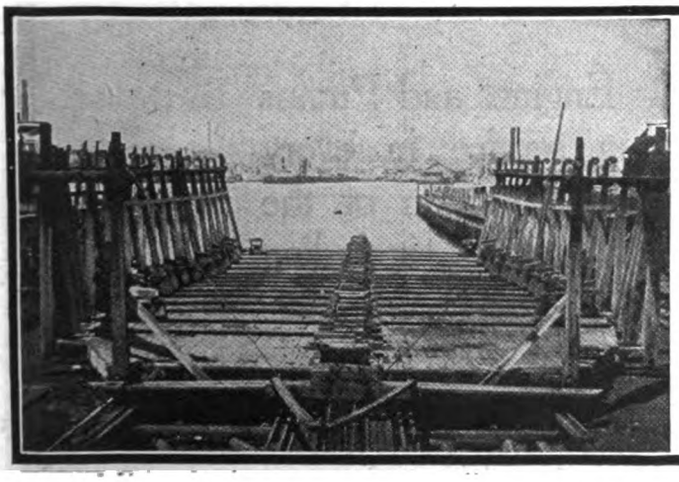

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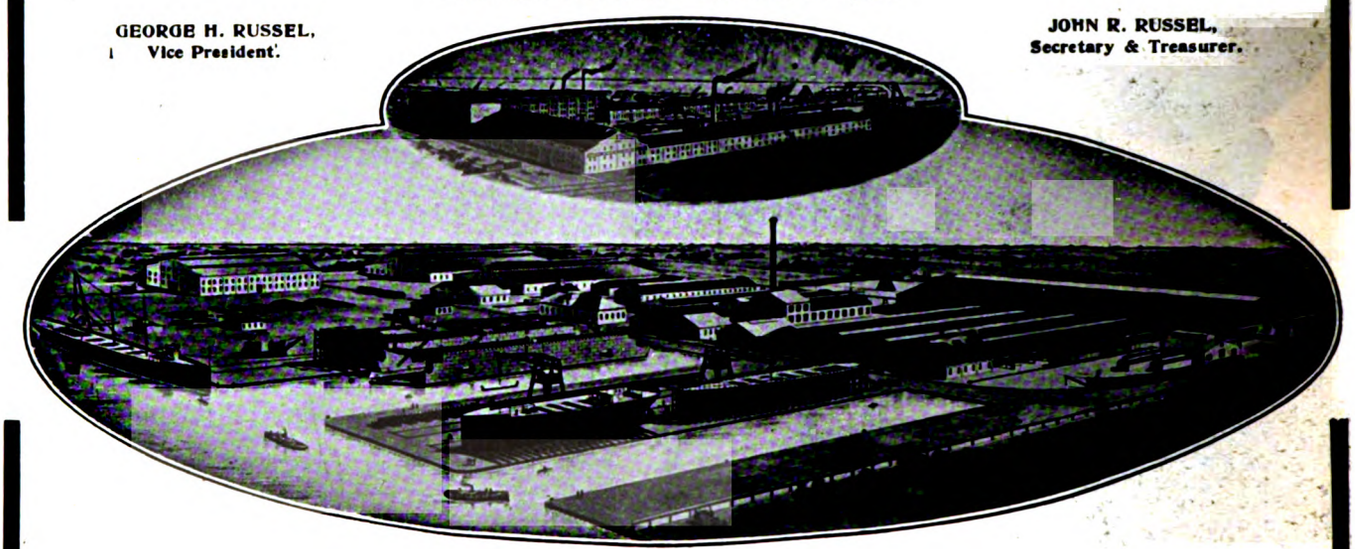

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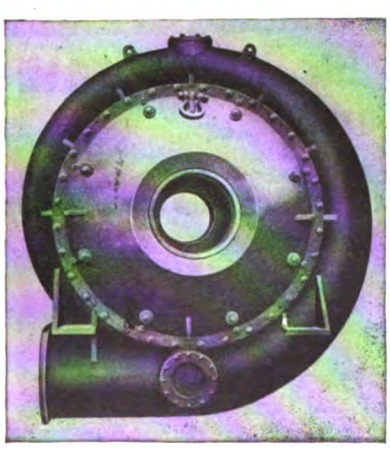

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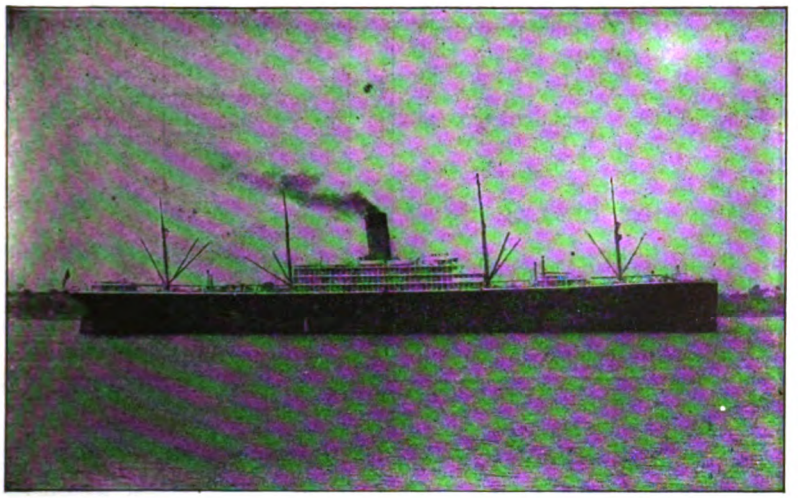

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Selected for the Minnesota and Dakota of the Great Northern Steamship Co.'s fleet—the largest vessels ever built in the United States. They are also being installed on nearly all of the vessels now building for the Navy Department, Revenue Cutter service, Lighthouse Board and the United States Coast Survey.

Reason—Their Superiority

Send for Illustrated Catalog.

HYDE WINDLASS COMPANY

BATH, MAINE

Geo. L. McCurdy

169 Jackson Boulevard

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IRON STEEL
PIG IRON
COKE
Cleveland, Ohio.

The Water Light

Self-Igniting Inextinguishable

For

Life Saving — Salvage
Distress Signal — Submarine
Repairs and Construction. — General Illumination.

Send for Sample. *Agents wanted.*

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BALTIMORE, MD.

Especially approved by The British Board of Trade, either of Life Buoy Lights or Deck Flare.

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WANTED and FOR SALE

PROPOSALS.

Proposals for dredges.—U. S. Engineer Office, Custom House, St. Louis, Mo., July 18, 1906. Sealed proposals, in triplicate, for construction and delivery of two self-propelling hydraulic dredges and their pontoon pipe lines will be received here until 12 noon, standard time, August 20, 1906, and then publicly opened. Information furnished on application. Thomas L. Casey, Major, Engrs.

U. S. Engineer Office, Jones Building, Detroit, Mich., Aug. 2, 1906. Sealed proposals for dredging Shoal 28 in Mud Lake, St. Marys River, Mich., will be received at this office until 2 p. m., Aug. 17, 1906, and then publicly opened. Information furnished on application. Chas. E. L. B. Davis, Col., Engineers.

Sealed proposals, in duplicate, endorsed "Proposals for Coal-Handling Plant, U. S. Naval Coal Depot, California City Point, Cal.," will be received at the Bureau of Equipment, Navy Department, Washington, D. C., until 11 o'clock a. m., October 3, 1906, and then and there publicly opened, for furnishing and erecting in complete working order a coal-handling plant. Plans and specifications may be obtained on application to the Bureau of Equipment. WM. S. COWLES, Chief of Bureau, July 28, 1906.

FOR SALE.

Steamer T. S. Christie.

Length 160 ft.; beam 30 ft.; carrying capacity, lumber 525,000 ft., coal 800 tons. Rating in Inland Lloyds Register, A1½*, valuation $22,000. For price and particulars address Capt. P. Larsen, Box 249, Chicago, Ill.

For Sale, Tug Gladiator.

Length, 115 ft.; breadth, 22 ft.; depth, 12 ft. Steeple compound engine 22 x 42 x 30. Housed in forward. Tug can be seen under working conditions at Duluth, Minn., by applying to Split Rock Lumber Co., Duluth, Minn.

BRIEFS

Read everywhere by men with marine interests. They pull. Tell your wants on this page—say it in an inch or two.

1 Inch, 1 Time, 1 Dollar.

FOR SALE.

Steamer for Sale Cheap.

The lighthouse steamer Haze, 145 ft. long, 27-ft. beam, 9-ft. draught, 500 tons capacity, 300 horsepower engine and boiler, suitable for passenger or freight business, fully equipped. Steam capstan, donkey boiler. Jacob Ullman, 46 Lloyd street, Buffalo, N. Y.

Steamer Hazel.

FOR SALE.—The passenger and freight steamer "Hazel." Length, 93 ft.; beam, 18 ft.; draught about 7 ft. 6 in. For further particulars address R. B. Rice, Grand Haven, Mich.

For Sale.

1,000 h. p. fore and aft Neafie & Levy compound Engine; surface condenser; independent pumps.
Two 12-foot Scotch Boilers.
One 13½-foot Scotch Boiler.
One 10 16-25 x 16 triple expansion Engine.
Three 150-h. p. Almy Boilers.
One 200-h. p. Tregurtha Boiler.
One 14 30 x 24 fore and aft Engine and condenser.
One Williamson steering Engine.
One 10 k. w. electric lighting Set.
One 15 k. w. electric lighting Set.
One Providence Windlass, 50 fathoms 1½ in. chain.
Two thrust Shafts and Bearings, 8½ in. diameter.

MARVIN BRIGGS,
17 Battery place, New York, N. Y.

Boilers for Sale.

Five Scotch Boilers, allowed 160 lbs, steam. Good as new. ERIE MACHINERY CO., 729 Garfield Bldg.. Cleveland, O.

FOR SALE

Revolving or "Whirley" Derrick.
In good order.
Immediate possession.

Address:

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MAN WANTED near Cleveland, to show and assist us to sell properties. No experience necessary, if you are willing to let us teach you the real estate business. Salary $60.00 a month to start. Steady position to good man, who is willing to devote part of his time to handling customers. Address W. C. Cunningham, Andrus Bldg., Minneapolis, Minn.

INFORMATION WANTED regarding good farm for sale, with good title, somewhere near Cleveland. Give price, description and character of soil. Also state when possession can be had. Owners only, need answer. State how far from town. Address W. C. Cunningham, Andrus Bldg., Minneapolis, Minn.

Low Rate Excursion to New York City. Lake Shore Ry.

August 28 and 29 the Lake Shore & Michigan Southern Ry. will sell excursion tickets to New York City and return at very low rates—practically a half fare—good for return leaving New York City until Sept. 4th, inclusive. Any particulars from Ticket Agent or by writing to J. W. Daly, C. A. G. P. A., Cleveland, Ohio.

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THE NATIONAL
APPROVED BY LLOYDS.
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L. M. BOWERS & CO.,
Binghamton, N. Y.
Catalogue on Application.

The National and International
ANCHORS.
Furnished to the Lake Trade by
The Upson-Walton Co.,
CLEVELAND, O.

You can take the Machine to the work,

and save almost any amount of labor over cutting and threading pipe by hand with a cutter and stock.

Armstrong's Pipe Cutting and Threading Machines are light, strong, compact and portable up to 4".

This means dollars in your pocket, and you ought to investigate.

Interesting and complete catalogue free.

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314 Knowlton St., Bridgeport, Conn.

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FOR SALE

We have on hand at Ambridge, Pa., for immediate delivery, one steel barge of which the following is a general description :

Length over all	-	**173′ 0″**
Breadth (Moulded)	-	**26′ 0″**
**Depth " **	-	**10′ 0″**

The barge is of the open hold type with a twelve-in. (12″) deck side stringer forming a gangway at each side. The bilge or knuckle of this barge is rounded off to a radius of 12″, this construction being carried up rake to deck. The ends in elevation are rounded off forming rake of about 10′ 0″ radius. At each end at foot of rake, a steel, watertight collision bulkhead is fitted, forming with the rake framing a substantial construction for towing purposes. Heavy cross beams are fitted about 30′ 0″ apart and at tow posts. The ordinary transverse framing is spaced about 2′ 0″ apart and deep floors and web frames are arranged about 15′ 0″ apart and at tow posts.

At the ends, a working deck is fitted and an ample number of towing posts are provided for the proper handling of the barge. A rubbing strake is fitted on the side and ends of this barge and two pump casings or boxes are provided. This barge is well adapted for carrying bulk cargoes such as coal, etc., but it should be noted that there is no wood ceiling laid on floors. The carrying capacity in short tons on a fresh water basis is as follows :

At 8′ 0″ draft	-	**970 tons.**
At 6′ 0″ draft	-	**700 "**

For price and further particulars apply to the

American Bridge Co. of New York

FRICK BUILDING

PITTSBURG, PA.

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For a more complete classification than that represented by advertisers in The Marine Review, see the BLUE BOOK OF AMERICAN SHIPPING, Marine and Naval Directory of the United States, published by The Marine Review, Cleveland.

[See accompanying Index of Advertisers for full addresses of concerns in this Directory.]

AIR COMPRESSION, HOISTS.
Great Lakes Engineering Works....Detroit.

AIR PORTS, DEAD LIGHTS, ETC.
Marine Mfg. & Supply Co.....New York.

AIR PUMPS AND APPLIANCES.
Fore River Ship & Engine Co.....Quincy, Mass.
Great Lakes Engineering Works....Detroit.

ANCHORS.
Bowers, L. M. & Co.....Binghamton, N. Y.

ANTI-FRICTION METALS.
Cramp, Wm. & Sons....Philadelphia.

ARTIFICIAL DRAFT FOR BOILERS.
American Ship Building Co.....Cleveland.
Detroit Ship Building Co....Detroit.
Great Lakes Engineering Works....Detroit.

ASH EJECTORS.
Great Lakes Engineering Works....Detroit.

ATTORNEYS AND PROCTORS IN ADMIRALTY.
Gilchrist, Albert J.....Cleveland.
Goulder, Holding & Masten.....Cleveland.
Hoyt, Dustin & Kelley....Cleveland.
Jenkins, Russell & Eichelberger....Cleveland.
Kremer, C. E. .....Chicago.
MacDonald, Ray G.....Chicago.
Shaw, Warren, Cady & Oakes.....Detroit.
White, Johnson, McCaslin & Cannon.....Cleveland.

BAROMETERS, MARINE GLASSES, ETC.
Ritchie, E. S. & Sons.....Brookline, Mass.

BELTING (LEATHER.)
Republic Belting & Supply Co.....Cleveland.

BLOCKS, SHEAVES, ETC.
Boston Lockport Block Co.....Boston, Mass.

BOAT BUILDERS.
Drein, Thos. & Son.....Wilmington, Del.
Kahnweiler's Sons, David.....New York.
Marine Construction & D. D. Co....Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co.....St. Joseph, Mich.

BOILER COMPOUNDS.
The Bird-Archer Co.....New York
Dearborn Drug & Chemical Works.....Chicago.
Lake Erie Boiler Compound Co.....Buffalo
State Manufacturing Co...Cleveland.

BOILER MANUFACTURERS.
Almy Water Tube Boiler Co.....Providence, R. I.

BOILER MANUFACTURERS—Continued.
American Ship Building Co.....Cleveland.
Atlantic Works..East Boston, Mass.
Chicago Ship Building Co..Chicago.
Cramp, Wm. & Sons..Philadelphia.
Dearing Water Tube Boiler Co.....Detroit.
Detroit Ship Building Co....Detroit.
East End Boiler Works....Detroit.
Fletcher, W. A. & Co.....Hoboken, N. J.
Fore River Shipbuilding Co.....Quincy, Mass.
Great Lakes Engineering Works....Detroit.
Kingston Foundry & Machine Works .....Oswego, N. Y.
Lake Erie Boiler Wks.....Buffalo
Maryland Steel Co.....Sparrow's Point, Md.
Milwaukee Dry Dock Co.....Milwaukee.
Mosher Water Tube Co..New York.
Newport News Ship Building Co..Newport News, Va.
New York Shipbuilding Co.....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co.....Duluth, Minn.
Quintard Iron Works Co.....New York.
Roberts Safety Water Tube Boiler Co. .....New York.
Superior Ship Building Co.....Superior, Wis.
Taylor Water Tube Boiler Co....Detroit.
Toledo Ship Building Co.....Toledo.

BOILER RIVETS.
Bourne-Fuller Co.....Cleveland.

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Falls Hollow Staybolt Co.....Cuyahoga Falls, O.

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Fore River Ship & Engine Co.....Quincy, Mass.
Great Lakes Engineering Works..Detroit.
Lunkenheimer Co.....Cincinnati.

BRIDGES, BUILDERS OF.
Scherzer Rolling Lift Bridge Co....Chicago.

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Brown Hoisting & Conveying Machine Co.....Cleveland.

CABIN AND CABINET FINISHING WOODS.
Martin-Barriss Co.....Cleveland.

CANVAS SPECIALTIES.
Baker & Co., H. H.....Buffalo.
Bunker, E. A.....New York.
Upson-Walton Co.....Cleveland.
Republic Belting & Supply Co....Cleveland.

CAPSTANS.
American Ship Windlass Co.....Providence, R. I.
Dake Engine Co.....Grand Haven, Mich.
Hyde Windlass Co.....Bath, Me.
Marine Mfg. & Supply Co.....New York.

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Smooth-On Mfg. Co.....Jersey City, N. J.

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General Electric Co.....Schenectady, N. Y.

CHAIN HOISTS.
Boston & Lockport Block Co.....Boston, Mass.
Republic Belting & Supply Co.....Cleveland, O.

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Penton Publishing Co....Cleveland

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Pickands, Mather & Co....Cleveland.
Pittsburg Coal Co.....Cleveland

COAL AND ORE HANDLING MACHINERY.
Brown-Hoisting Machinery Co.....Cleveland.

COMPASSES.
Ritchie, E. S. & Son.....Brookline, Mass.

CONDENSERS.
Great Lakes Engineering Works....Detroit.
Thropp & Sons Co., John E.....Trenton, N. J.
Wheeler Condenser & Engineering Co.....New York.

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Buffalo Dredging Co.....Buffalo.
Dunbar & Sullivan Dredging Co....Buffalo.
Great Lakes Dredge & Dock Co....Chicago.
Hickler Bros.....Sault Ste. Marie, Mich.
Hubbell Co., H. W..Saginaw, Mich
Smith Co., L. P. & J. A...Cleveland.
Starke Dredge & Dock Co., C. H...Milwaukee.
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Sullivan, M.....Detroit

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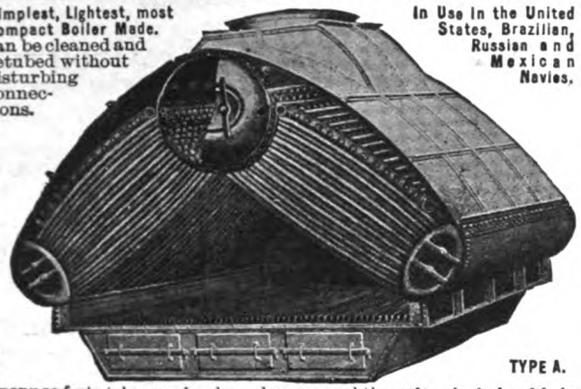
THE MOSHER PATENT WATER TUBE BOILER

Simplest, Lightest, most Compact Boiler Made. can be cleaned and retubed without disturbing connections.

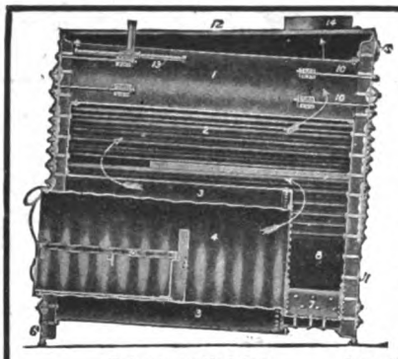
In Use in the United States, Brazilian, Russian and Mexican Navies.



TYPE A.

As many as forty tubes can be cleaned or renewed through a single hand-hole; has greater steam and water capacity than any other water tube boiler. Send for descriptive catalogue.

MOSHER WATER TUBE BOILER CO., NO. 1 BROADWAY, N. Y.



Detroit Scotch Water Tube Boiler

Internally Fired.

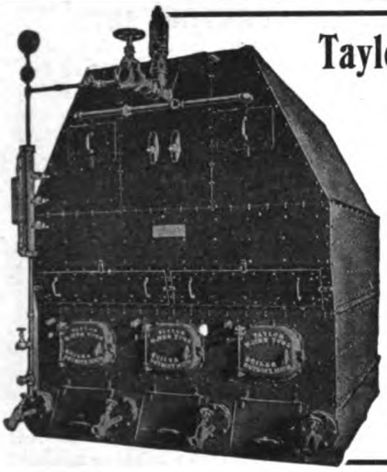
Scotch and Water Tube types combined, eliminating all objections.

Half the weight of ordinary Scotch boilers.

Standard corrugated furnaces.

Patent applied for. Investigate before buying any other.

EAST END BOILER WORKS
Detroit, Mich.

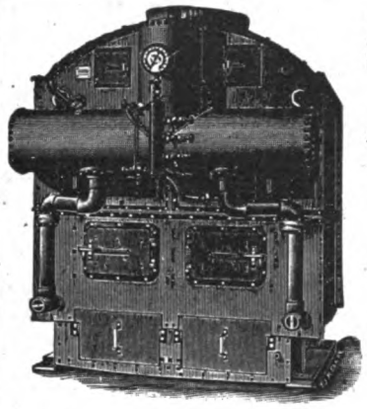


Taylor Water Tube Boiler Co.

Vertical Tubes, sectional, large steam space and liberating area.
Fire box, combustion chamber, and course for the furnace gases similar to the Scotch Marine.
Free circulation type.

Send for full description.

322 Franklin St.
DETROIT, MICH.



350 STEAM VESSELS

Now Equipped With

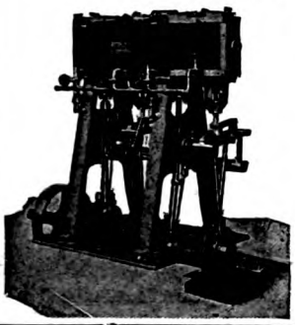
ALMY'S PATENT SECTIONAL Water Tube Boilers

Bear Evidence of Their

Excellent Qualities

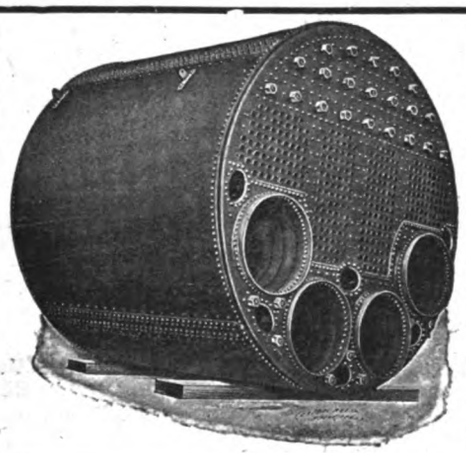
ALMY WATER-TUBE BOILER CO.
PROVIDENCE, R. I.

John E. Thropp & Sons Co.
TRENTON, N. J.



Builders of Single, Compound, Triple-Expansion and Direct Connected Engines.

Boyer Sectional Water Tube boilers and machinery complete for light draft Passenger Boats, Yachts, Tugs, Etc.



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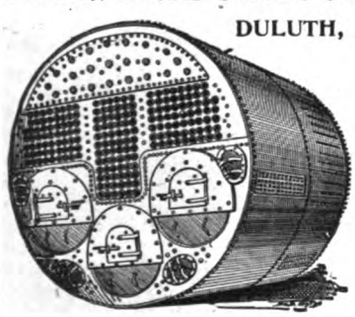
OF ALL TYPES

KINGSFORD FOUNDRY & MACHINE WORKS,
Oswego, N.Y.

Northwestern Steam Boiler & Mfg. Co.
DULUTH, MINN.



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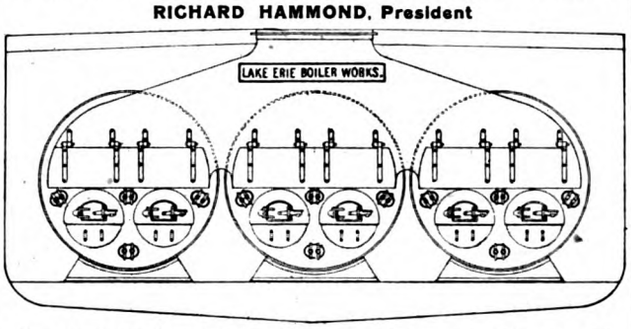
J. H. OPPERMAN, *Secretary*, 579-R; E. KRIZ, *Superintendent*, 557-M.

LAKE ERIE BOILER WORKS
RICHARD HAMMOND, President



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Milwaukee Dry Dock Co.....
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Tietjen & Lang Dry Dock Co.....
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....Trenton, N. J.

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General Electric Co.....
.....Schenectady, N. Y.

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Thropp & Sons, John E.....
.....Trenton, N. J.

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Chicago Ship Building Co., Chicago.
Chase Machine Co.....Cleveland.
Cramp, Wm. & Sons, Philadelphia.
Detroit Ship Building Co., Detroit.
Fletcher, W. & A. Co., Hoboken, N. J.
Fore River Shipbuilding Co.....
..... Quincy, Mass.

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Lockwood Mfg. Co.....
.....East Boston, Mass.
Maryland Steel Co.....
.....Sparrows Point, Md.
Milwaukee Dry Dock Co., Milwaukee.
Mosher, Chas. D.....New York.
Newport News Ship Building Co....
.....Newport News, Va.
New York Ship Building Co.....
.....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co. ..... Duluth, Mich.
Quintard Iron Works Co., New York.
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Sheriffs Mfg. Co.....Milwaukee.
Superior Ship Building Co.....
..... Superior, Wis.
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.....Trenton, N. J.
Toledo Ship Building Co.....Toledo.
Trout, H. G.....Buffalo.

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Marine Mfg. Supply Co., New York.

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Northwestern Steam Boiler & Mfg. Co. ..... Duluth, Minn.

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Hunt, Robt. W. & Co.....Chicago.
Kidd, Joseph.....Duluth, Minn.
Mosher, Chas. D.....New York.
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Roelker, H. B.....New York.
Wood, W. J.....Chicago.

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Wheeler Condenser & Engineering Co. ..... New York.

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Fix's S. Sons.....Cleveland.

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Parker Bros. Co., Ltd.....Detroit.
Pickands, Mather & Co., Cleveland.
Pittsburg Coal Co.....Cleveland.
Smith, Stanley B., & Co., Detroit.
Toledo Fuel Company, ...Toledo, O.

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GRAPHITE.
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.....Jersey City, N. J.

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Chase Machine Co.....Cleveland.

HOISTS FOR CARGO, ETC.
American Ship Building Co.....
..... Cleveland.
Brown Hoisting Machinery Co.....
..... Cleveland.
Chase Machine Co.....Cleveland.
Dake Engine Co.....
.....Grand Haven, Mich.
General Electric Co.....New York.
Hyde Windlass Co.....Bath, Me.
Marine Iron Co.....Bay City.

HOLLOW STAYBOLT IRON.
Falls Hollow Staybolt Co.....
.....Cuyahoga Falls, O.

HYDRAULIC DREDGES.
Great Lakes Engineering Works....
.... Detroit.

HYDRAULIC TOOLS.
Watson-Stillman Co., The.....
..... New York.

ICE MACHINERY.
Great Lakes Engineering Works....
..... Detroit.
Roelker, H. B.....New York.

INJECTORS.
American Injector Co.....Detroit.
Jenkins Bros.....New York.
Lunkenheimer Co. ..... Cincinnati.
Penberthy Injector Co.....
..... Detroit, Mich.

INSURANCE, MARINE.
Elphicke, C. W. & Co.....Chicago.
Gilchrist & Co., C. P.....Cleveland.
Hawgood & Co., W. A., Cleveland.
Helm & Co., D. T.....Duluth.
Hutchinson & Co.....Cleveland.
McCarthy, T. R.....Montreal.
McCurdy, Geo. L.....Chicago.
Mitchell & Co.....Cleveland.
Parker Bros. Co., Ltd.....Detroit.
Peck, Chas. E. & W. F.....
.....New York and Chicago.
Prindiville & Co.....Chicago.
Richardson, W. C.....Cleveland.
Sullivan, D. & Co.....Chicago.

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G. H. Breymann & Bro's

CONTRACTORS FOR
PUBLIC WORKS

Dredging, Dock Building, Etc.

5, 6 AND 7 MARINE BUILDING
TOLEDO, OHIO.

Great Lakes Dredge & Dock Company

RIVER AND HARBOR IMPROVEMENTS

Foundations, Bridges, Piers, Breakwaters, Lighthouses, Tunnels, Pneumatic and Submarine Work.

CHICAGO

DULUTH CLEVELAND TOLEDO

SAULT STE. MARIE

Buffalo Dredging Co.

GENERAL CONTRACTORS
ON
SUBMARINE WORK

Office
D. S. Morgan Bldg. BUFFALO, N. Y.

DUNBAR & SULLIVAN DREDGING CO.
BUFFALO, N. Y.

Ready for Spring A New Tool

A REVOLVING CLAMSHELL DREDGE

which will do the following impossibilities to the ordinary dredge:

Excavate 60′ back from face of dock into scow or vice versa. Excavate at either end of itself and dump in scow at other end. This makes through cutting and cleaning narrow slips cheaply possible. Excavate trenches to 150′ or more depth. Excavate material and throw it one side 150′ from original site where there is four feet of water between dump and channel. Excavate shallow channels down to 4′ x 44′. Clean out boulders or obstructions without disturbing surrounding bottom. Excavate close to docks without injury to dock. Anything that ordinary derrick will do up to 10 tons at 75′ radius.

This is an excellent wrecking tool.

Hickler Brothers

SAULT STE. MARIE, MICH.

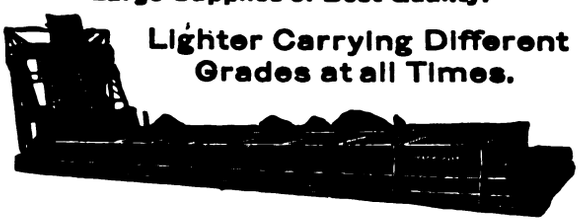
MARINE RAILWAY

Capacity, 1,000 tons. Draft, 7½ ft. forward, 13½ ft. aft. Length on keel blocks, 180 ft.; over all, 190 ft.

Machine Shop, Foundry and Steam Forge, Dredges, Drill Boats and Derrick Scows.

Steamboat Fuel at Ashtabula.

Large Supplies of Best Quality.



Lighter Carrying Different Grades at all Times.

Fuel Scow with elevators and discharging spouts. Storage of 800 tons. Discharges 250 tons an hour into steamers while unloading cargo.

M. A. Hanna & Co., *Miners and Shippers,*
Main Office, Perry-Payne Bldg., Cleveland.

H. W. HUBBELL CO.

Submarine Work
of all kinds

Dredging Hard Material a Specialty.

SAGINAW - - MICH.

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Buyers' Directory of the Marine Trade---*Continued.*

IRON ORE AND PIG IRON.
Bourne-Fuller Co.....Cleveland, O.
Hanna, M. A. & Co.....Cleveland.
Pickands, Mather & Co., Cleveland.

LAUNCHES—STEAM, NAPHTHA, ELECTRIC.
Truscott Boat Mfg. Co.....
.....St. Joseph, Mich.

LIFE PRESERVERS, LIFE BOATS, BUOYS.
Armstrong Cork Co.....Pittsburg.
Carley Life Float Co.....
.....New York, N. Y.
Drein, Thos. & Son.....
..... Wilmington, Del.
Kahnweiler's Sons, D.....New York.

LIGHTS, SIDE AND SIGNAL.
Russell & Watson.....Buffalo.

LOGS.
Nicholson Ship Log Co., Cleveland.
Walker & Sons, Thomas.....
..... Birmingham, Eng.

LUBRICATING GRAPHITE.
Dixon Crucible Co., Joseph.....
.....Jersey City, N. J.

LUBRICATORS.
Lunkenheimer Co. ..... Cincinnati.

LUMBER.
Martin-Barriss Co. ..... Cleveland.

MACHINISTS.
Chase Machine Co.....Cleveland.
Hickler Bros., Sault Ste. Marie, Mich.
Lockwood Mfg. Co.....
.....East Boston, Mass.

MACHINE TOOLS (WOOD WORKING).
Atlantic Works, Inc....Philadelphia.

MARINE RAILWAYS.
Hickler Bros., Sault Ste. Marie, Mich.

MARINE RAILWAYS, BUILDERS OF.
Crandall & Son, H. I.....
.....East Boston, Mass.

MATTRESSES, CUSHIONS, BEDDING.
Fogg, M. W.....New York

MECHANICAL DRAFT FOR BOILERS.
American Ship Building Co.....
..... Cleveland.
Detroit Ship Building Co., Detroit.
Great Lakes Engineering Works....
..... Detroit.

METALLIC PACKING.
Katzenstein, L. & Co., New York.
The National Metallic Packing Co..
.....Oberlin, O.

MOTORS, GENERATORS—ELECTRIC.
General Electric Co.....
.....Schenectady, N. Y.

NAUTICAL INSTRUMENTS.
Ritchie, E. S., & Sons.....
..... Brookline, Mass.

NAVAL ARCHITECTS.
Hynd, Alexander .....Cleveland
Kidd, Joseph .....Duluth, Minn.
Mosher, Chas. D.....New York.
Nacey, James .....Cleveland
Wood, W. J.....Chicago

OAKUM.
Stratford, Oakum Co.....
.....Jersey City, N. J.

OILS AND LUBRICANTS.
Dixon Crucible Co., Joseph.....
.....Jersey City, N. J.

PACKING.
Jenkins Bros.....New York.
Katzenstein, L. & Co...New York.
Robertson, Jos. L. & Sons.....
....New York.
The National Metallic Packing Co...
..... Oberlin, O.
Republic Belting & Supply Co.....
.....Cleveland, O.

PAINTS.
Baker, Howard H. & Co....Buffalo.
Upson-Walton Co.....Cleveland.

PATTERN SHOP MACHINERY.
Atlantic Works, Inc. ..Philadelphia.

PILE DRIVING AND SUBMARINE WORK.
Buffalo Dredging Co.....Buffalo.
Dunbar & Sullivan Dredging Co....
.... Buffalo.
Great Lakes Dredge & Dock Co....
.... Chicago.
Hickler Bros..Sault Ste. Marie, Mich.
Hubbell Co., H. W...Saginaw, Mich.
Parker Bros. Co., Ltd.....Detroit.
Smith Co., L. P. & J. A...Cleveland.
Starke Dredge & Dock Co., C. H...
....Milwaukee.
Sullivan, M.....Detroit.

PIPE, WROUGHT IRON.
Bourne-Fuller Co.....Cleveland, O.

PLANING MILL MACHINERY.
Atlantic Works, Inc....Philadelphia.

PLATES—SHIP, STRUCTURAL, ETC.
Bourne-Fuller Co.....Cleveland, O.
Otis Steel Co.....Cleveland.

PRESSURE REGULATORS.
Ross Valve Co.....Troy, N. Y.

PROPELLER WHEELS.
American Ship Building Co.....
..... Cleveland.
Atlantic Works ..East Boston, Mass.
Cramp, Wm. & Sons..Philadelphia.
Detroit Ship Building Co....Detroit.
Fore River Shipbuilding Co.....
..... Quincy, Mass.
Great Lakes Engineering Works....
.... Detroit.
Hyde Windlass Co.....Bath, Me.
Lockwood Mfg. Co.....
.....East Boston, Mass.
Milwaukee Dry Dock Co.....
....Milwaukee.
Newport News Ship Building Co..
.....Newport News, Va.
Roelker, H. B.....New York.
Sheriffs Mfg. Co.....Milwaukee.
Superior Ship Building Co.....
.....Superior, Wis.
Thropp & Sons Co., J. E.....
.....Trenton, N. J.
Toledo Ship Building Co.....Toledo.
Trout, H. G.....Buffalo.

PROJECTORS, ELECTRIC.
General Electric Co.....
.....Schenectady, N. Y.

PUMPS FOR VARIOUS PURPOSES.
Great Lakes Engineering Works..
.... Detroit.
Kingsford Foundry & Machine Works .....Oswego, N. Y.
Wheeler Condenser & Engineering Co. .....New York.

REFRIGERATING APPARATUS.
Great Lakes Engineering Works....
.... Detroit.
Roelker, H. B.....New York.

REGISTER FOR CLASSIFICATION OF VESSELS.
Great Lakes Register.....Cleveland.

RIVETS, STEEL FOR SHIPS AND BOILERS.
Bourne-Fuller Co.....Cleveland, O.

RUBBER SUPPLIES.
Republic Belting & Supply Co.....
..... Cleveland, O

SAFETY VALVES.
Lunkenheimer Co.....Cincinnati.

SAIL MAKERS.
Baker, Howard H. & Co....Buffalo.
Upson-Walton Co.....Cleveland.

SALVAGE COMPANIES.
See Wrecking Companies.

SEARCH LIGHTS.
General Electric Co.....
.....Schenectady, N. Y.

SHEARS.
See Punches, and Shears.

SHIP AND BOILER PLATES AND SHAPES.
Bourne-Fuller Co.....Cleveland, O.
Otis Steel Co.....Cleveland.

SHIP BUILDERS.
American Ship Building Co.....
.... Cleveland.
Atlantic Works ..East Boston, Mass.
Buffalo Dry Dock Co.....Buffalo.
Cramp, Wm. & Sons..Philadelphia.
Chicago Ship Building Co..Chicago.
Detroit Ship Building Co....Detroit.
Fore River Ship Building Co.....
....Quincy, Mass.
Great Lakes Engineering Works....
....Detroit.
Lockwood Mfg. Co.....
.....East Boston, Mass.
Manitowoc Dry Dock Co.....
.....Manitowoc, Wis.
Maryland Steel Co.....
.....Sparrow's Point, Md.
Milwaukee Dry Dock Co.....
.... Milwaukee.
Newport News Ship Building Co...
.....Newport News, Va.
New York Shipbuilding Co.....
.....Camden, N. J.
Roach's Ship Yard.....Chester, Pa.
Shipowner's Dry Dock Co..Chicago.
Toledo Ship Building Co.....Toledo.

SHIP CHANDLERS.
Baker, Howard H. & Co....Buffalo.
Marine Mfg. & Supply Co.....
..... New York
Upson-Walton Co.....Cleveland.

SHIP DESIGNERS.
Kidd, Joseph .....Duluth.
Steel, Nacey, & Hynd....Cleveland.
Wood, W. J.....Chicago.

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The Cleveland Dredge & Dock Co.

Successors to
The L. P. & J. A. SMITH COMPANY

CONTRACTORS FOR PUBLIC WORKS
AND ALL KINDS OF DOCK AND HARBOR IMPROVEMENTS

Offices: Williamson Bldg. CLEVELAND, O.

THE

Standard Contracting Co.

ENGINEERS AND CONTRACTORS

For Railroads, Dredging, Dock Building, Concrete, Submarine work, &c.

Wade Building Cleveland, Ohio

C. H. STARKE DREDGE & DOCK CO.,

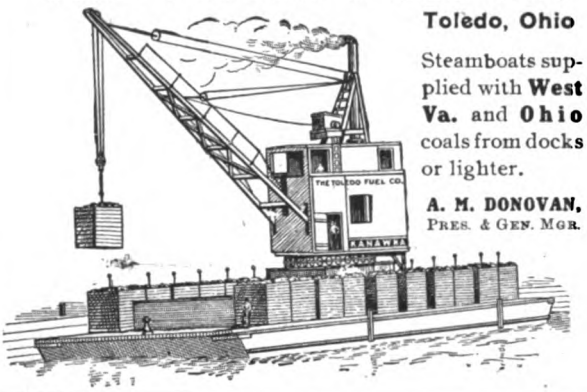
Contractors for Public Works.

DREDGING, PILE DRIVING,
AND
SUBMARINE PIPE LAYING.

Canal Street, West of First Avenue,

Milwaukee, - - Wisconsin.

The Toledo Fuel Co.



Toledo, Ohio

Steamboats supplied with **West Va.** and **Ohio** coals from docks or lighter.

A. M. DONOVAN,
PRES. & GEN. MGR.

M. SULLIVAN,

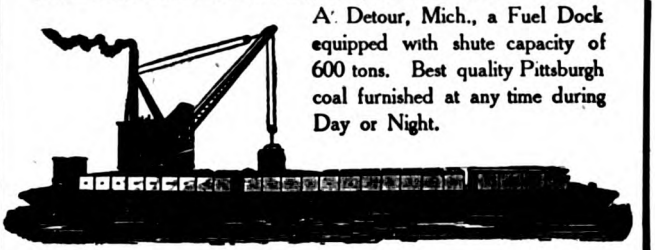
DREDGING OF ALL KINDS.

THE REMOVING OF DEEP WATER EARTH AND ROCK A SPECIALTY. - - -

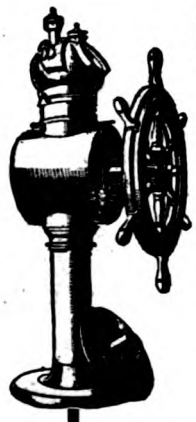
53 Woodward Ave. Terrace,
DETROIT, - - - MICH.

PICKANDS, MATHER & CO.

FUEL LIGHTERS at Buffalo, Erie, Ashtabula and Cleveland. At Detour, Mich., a Fuel Dock equipped with shute capacity of 600 tons. Best quality Pittsburgh coal furnished at any time during Day or Night.



Western Reserve Building, CLEVELAND, O.



MARINE MFG. & SUPPLY CO.

157 and 158 South St., New York.

SHIP FITTINGS AND SUPPLIES
CAPSTANS, WINDLASSES, STEERING APPARATUS, ENGINE ROOM TELEGRAPHS, BRASS AIR PORTS, DEAD LIGHTS, PUMPS, ETC.

Catalogue A—Air Ports, Ventilators, etc.
Catalogue B—Windlasses, Pumps, etc.
Catalogue C—Steering Apparatus.
Others in course of preparation.

FERRALL'S HUB HOISTER
AND
Sheave for Same.

The sheaves of these hoisters are fitted with Star Metaline Bushings and Side Bearings, which keep the sheaves from heating, make them run true and together with the rounded edges of the shells, soon save more than their cost, by preserving the rope.

BOSTON & LOCKPORT BLOCK CO.
BOSTON - MASS.

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SHIP LANTERNS AND LAMPS.
Upson-Walton Co..... Cleveland.

SHIP TIMBER.
Martin-Barriss Co.....Cleveland.

SIGNALS—SUBMARINE.
Submarine Signal Co.....Boston

SMOOTH-ON COMPOUND, FOR REPAIRS.
Smooth-On Mfg. Co.....
.....Jersey City, N. J.

STAYBOLT IRON OR STEEL BARS, HOLLOW OR SOLID.
Falls Hollow Staybolt Co.....
.....Cuyahoga Falls, O.

STEAM VESSELS FOR SALE.
Holmes, Samuel .....New York.
McCarthy, T. R.....Montreal, Can.

STEAMSHIP LINES, PASS, AND FREIGHT.
American Line .....New York.
Anchor Line .....Buffalo.
Boston Steamship .....Boston.
C. & B. Transit Co.....Cleveland.
International Mercantile Marine Co.
.... Philadelphia.
Mallory Line .....New York.
New York & Cuba Mail S. S. Co..
....New York.
Red Star Line .....New York.

STEAM SPECIALTIES.
Robertson, Jas. L. & Sons ..New York.

STEEL CASTINGS.
Otis Steel Co.....Cleveland.

STEERING APPARATUS.
American Ship Building Co.....
....Cleveland.
Chase Machine Co.....Cleveland.
Dake Engine Co.....
.....Grand Haven, Mich.
Detroit Ship Building Co....Detroit.
Hyde Windlass Co.....Bath, Me.
Marine Mfg. & Supply Co.....
....New York.
Sheriffs Mfg. Co.....Wilwaukee.

SUBMARINE DIVING APPARATUS.
Morse & Son, A. J.....Boston.
Schrader's Son, Inc. A....New York.

SURVEYORS, MARINE.
Hynd, Alexander .....Cleveland.
Parker Bros. Co., Ltd.....Detroit.
Nacey, James .....Cleveland.
Steel, Adam .....Cleveland.
Wood, W. J.....Chicago.

TESTS OF MATERIALS.
Hunt, Robert W. & Co....Chicago.
Lunkenheimer Co....Cincinnati, O.

THERMIT.
Goldschmidt Thermit Co., ...
..... New York City.

TOOLS, METAL WORKING, FOR SHIP AND ENGINE WORKS.
Watson-Stillman Co.....New York.

TOOLS, WOOD WORKING.
Atlantic Works, Inc....Philadelphia.

TOWING MACHINES.
American Ship Windlass Co.....
.....Providence, R. I.
Chase Machine Co.....Cleveland.

TOWING COMPANIES.
Donnelly Salvage & Wrecking Co..
.....Kingston, Ont.
Great Lakes Towing Co..Cleveland.

TRUCKS.
Boston & Lockport Block Co.....
..... Boston.

TUBING, SEAMLESS.
Shelby Steel Tube Co..Pittsburg, Pa.

VALVES, STEAM SPECIALTIES, ETC.
Jenkins Bros. .....New York
Lunkenheimer Co.....Cincinnati.
Ross Valve Co.....Troy, N. Y.

VALVES FOR WATER AND GAS.
Ashton Valve Co.,.....Boston.
Lunkenheimer Co.....Cincinnati.
Republic Belting & Supply Co.....
....Cleveland, O.
Ross Valve Co.....Troy, N. Y.

VESSEL AND FREIGHT AGENTS.
Boland, John J.....Buffalo.
Douglas, G. L. Jr.....Duluth
Elphicke, C. W. & Co.....Chicago.
Hall, John B.....Buffalo.
Helm & Co., D. T.....Duluth.
Hawgood & Co., W. A....Cleveland.
Holmes, Samuel .....New York.
Hutchinson & Co.....Cleveland.
McCarthy, T. R.....Montreal.

VESSELS AND FREIGHT AGENTS—Con.
Mitchell & Co.....Cleveland.
Parker Bros. Co., Ltd.....Detroit.
Prindiville & Co.....Chicago.
Richardson, W. C.....Cleveland.
Sullivan, D. & Co.....Chicago

WATER GAUGES.
Lunkenheimer Co.....Cincinnati, O.

WHISTLES, STEAM.
Lunkenheimer Co.....Cincinnati.

WILFORD'S WATERPROOF CLOTH.
Bunker, E. A..... New York.

WIRE ROPE AND WIRE ROPE FITTINGS.
Baker, H. H. & Co.....Buffalo.
Upson-Walton Co.....Cleveland.

WINDLASSES.
American Ship Windlass Co.....
..... Providence, R. I.
American Ship Building Co.....
..... .Cleveland.
Dake Engine Co.....
.....Grand Haven, Mich.
Hyde Windlass Co.....Bath, Me.
Marine Mfg. & Supply Co.....
....New York.

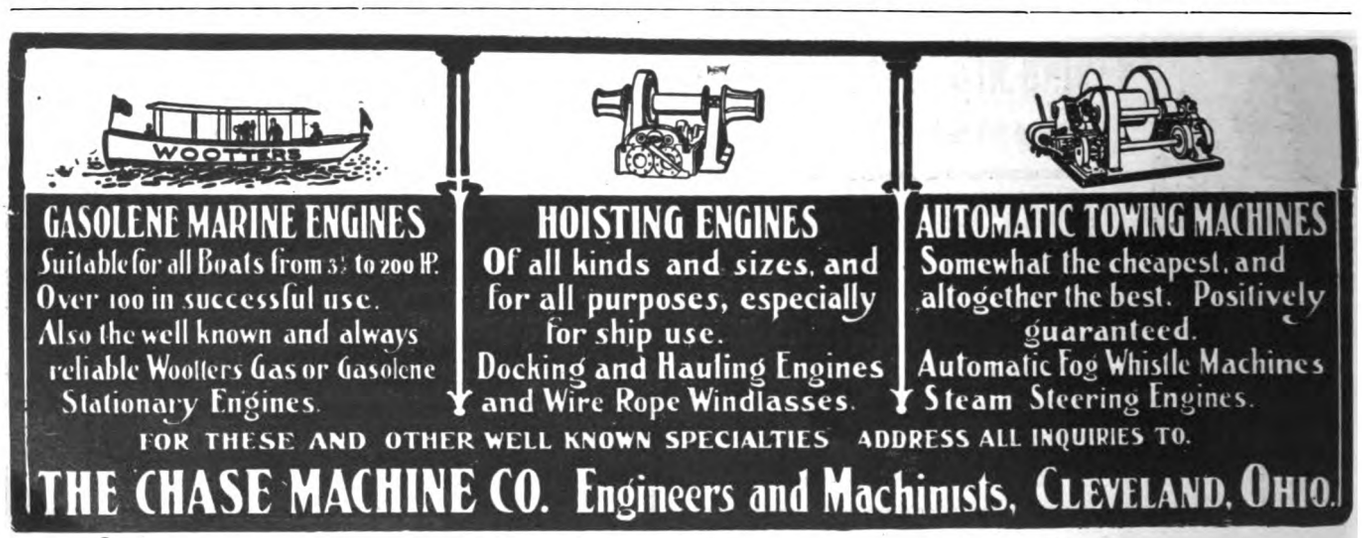
WINCHES.
American Ship Windlass Co.....
.....Providence, R. I.
Hyde Windlass Co.....Bath, Me.

WOOD WORKING MACHINERY.
Atlantic Works, Inc....Philadelphia.

WRECKING AND SALVAGE COMPANIES.
Donnelly Salvage & Wrecking Co..
..... Kingston, Ont.
Great Lakes Towing Co..Cleveland.
Parker Bros. Co., Ltd.....Detroit.

YACHT AND BOAT BUILDERS.
Drein, Thos. & Son.....
..... Wilmington, Del.
Manitowoc Dry Dock Co.....
..... Manitowoc, Wis.
Truscott Boat Mfg. Co.....
.....St. Joseph, Mich.

YAWLS.
Drein, Thos. & Son.....
..... .Wilmington, Del.


WOOTTERS
GASOLENE MARINE ENGINES
Suitable for all Boats from 3½ to 200 H.P.
Over 100 in successful use.
Also the well known and always reliable Woolters Gas or Gasolene Stationary Engines.
HOISTING ENGINES
Of all kinds and sizes, and for all purposes, especially for ship use.
Docking and Hauling Engines and Wire Rope Windlasses.
AUTOMATIC TOWING MACHINES
Somewhat the cheapest, and altogether the best. Positively guaranteed.
Automatic Fog Whistle Machines
Steam Steering Engines.
FOR THESE AND OTHER WELL KNOWN SPECIALTIES ADDRESS ALL INQUIRIES TO.
THE CHASE MACHINE CO. Engineers and Machinists, CLEVELAND, OHIO.

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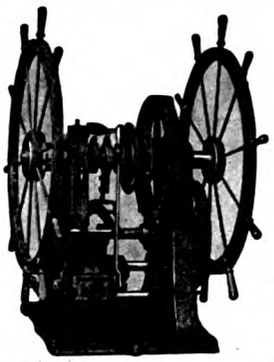
SHERIFFS
MANUFACTURING CO.
Manufacturers of
PROPELLER
WHEELS
Marine Engines
and Repairs.
Milwaukee, Wis.
Phone S. 163

Dake Pilot House
Steam Steerer



For Tugs and Steamers. Simple, Durable, Efficient and practically noiseless. Can easily be changed to hand gear if necessary.

DAKE ENGINE CO.,
Grand Haven, Mich.

Dixon's Graphite for Marine Lubrication

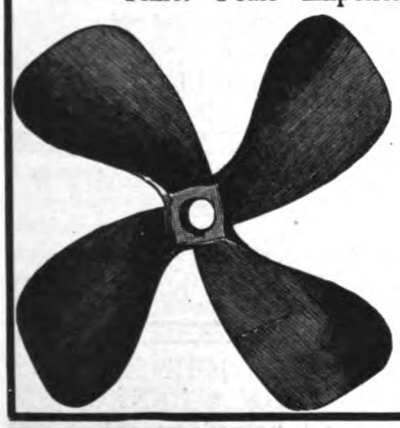
Lieut Dinger, U. S N., said: "Flake Graphite is not affected, chemically or physically, by any temperature encountered in a cylinder—pumps run better with graphite and a little kerosene than with oil."

His complete article is given in Booklet 77-C. Free on request together with test samples of Dixon's Graphite.

JOSEPH DIXON CRUCIBLE CO.
JERSEY CITY, N. J.

BELTING
The Republic
Belting and Supply Company
Cleveland, O.
FORMERLY THE BODIFIELD BELTING CO.
Manufacturers of
LEATHER BELTING
"REPUBLIC"
Mechanical Rubber Goods.
Goodyear's Interlocking Rubber Tiling.
LEATHER-RUBBER
—CANVAS-COTTON—

Thirty Years' Experience building



Engines
and
Propeller Wheels.

H. G. TROUT,
King Iron Works,
226 Ohio St.,
BUFFALO, N. Y.

Aids to Navigation
are of vital importance to vessel interests.
SCHERZER ROLLING LIFT BRIDGES
aid navigation and meet with the approval of all vessel interests, because of the wide and unobstructed channel provided for navigation, enabling vessels to pass easily and rapidly through the draw.
The Scherzer Rolling Lift Bridge Co.
Main Offices: 1616 Monadnock Block,
CHICAGO, U. S. A.

ANY SIZE, OUTSIDE OR INSIDE DIAMETER.
AVERAGE LENGTH OF HOLLOW BARS
EIGHT TO TEN FEET.
FALLS HOLLOW STAYBOLT Co
STAYBOLT BARS
BOTH HOLLOW AND SOLID,
MADE OF BEST QUALITY DOUBLE REFINED CHARCOAL
IRON OR STEEL.
CUYAHOGA FALLS, O. U.S.A.

Makers of only the Highest Quality of Staybolt Material, in Hollow and Solid Bars, from the Best Double-Refined Charcoal Iron or Steel.

FALLS HOLLOW STAYBOLT IRON Is the only Reliable Flexible Staybolt in the World.

The Only Staybolt Iron which responds in service to the expansion and contraction of fire box; which relieves the material in molecular strains; which is self protective from burning; which does not make the side sheets crack; which earns its own cost in oxygen through it to the fire; always sure in giving warning of breakage.

The Staybolt which lasts longest, requires least repairs, gives longest life to the fire box, and the longest service in the engine on the rails.

In use by Leading Railways of the United States, Canada, Mexico, Japan and Norway. Also by Marine Engineers and the United States Government. And by the Manufacturers of Mining Drills and by others requiring absolutely reliable material.

GEO. STRATFORD OAKUM CO.
JERSEY CITY, NEW JERSEY.
Established 1860

Manufacturers of all grades of
Oakum
Spun Cotton

FOR SALE AT SHIP CHANDLERS EVERYWHERE.

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VESSEL AND INSURANCE AGENTS.

FRED P. BELCHER,
Vessel and Insurance Agent,
430 Grain Exchange,
WINNIPEG, MAN.
P. O. Box 230.

JOHN J. BOLAND & CO.,
Vessel and Insurance Agents.
800-804 Prudential Bldg.
Both Phones. BUFFALO, N. Y.

C. W. Elphicke. J. J. Rardon.
C. W. ELPHICKE & CO.
Vessel and Insurance Agents.
No. 6 Sherman St. CHICAGO, ILL.
Telephone, Harrison 1194.

JOHN B. HALL,
Vessel Agent.
17 Exchange Bldg., 202 Main St.,
Telephone, Seneca 892.
BUFFALO, N. Y.

W. A. Hawgood. Arthur H. Hawgood.
W. A. HAWGOOD & CO.
Vessel and Insurance Agents.
220-21 Perry-Payne Bldg., Cleveland, O.
Telephones: Office, Main 2395.
Res. W. A. Hawgood, Doan 84-J.
Res. A. H. Hawgood, Doan 841-J.

D. T. HELM & CO.
Vessel and Insurance Agents.
Telephones—Office 263.
—Res. 381-3.
DULUTH, - - - - MINN.

SAMUEL HOLMES,
Steamship Offices,
For Selling, Chartering and Building all Classes Steam Vessels.
Steam Vessel Circulars Weekly Freight Circulars.
Morris Bldg., 66-8 Broad St., New York.

C. L. Hutchinson. W. H. McGean.
HUTCHINSON & CO.
Vessel and Insurance Agents.
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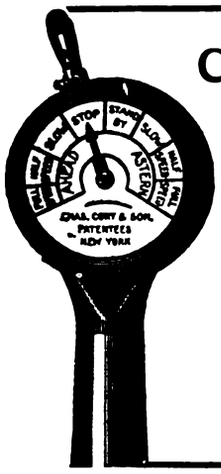

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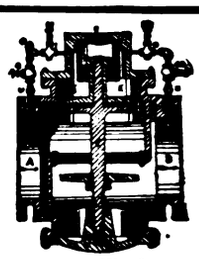

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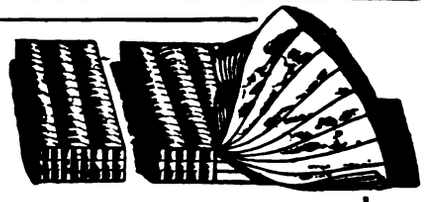

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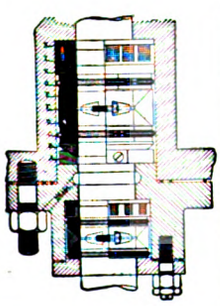

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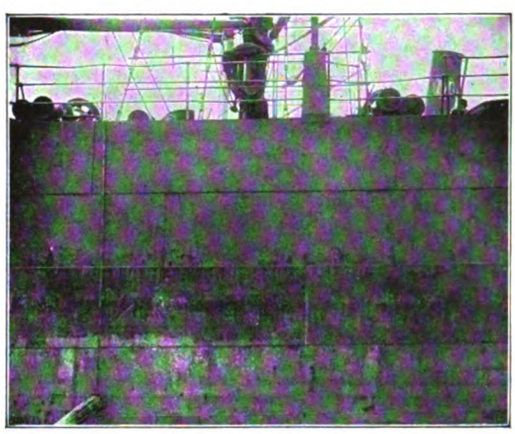

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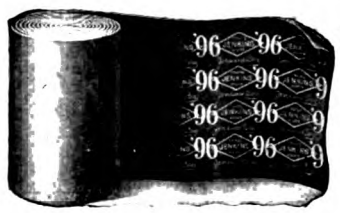

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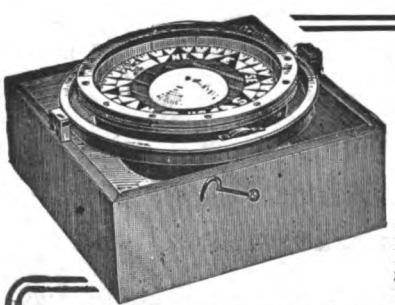

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